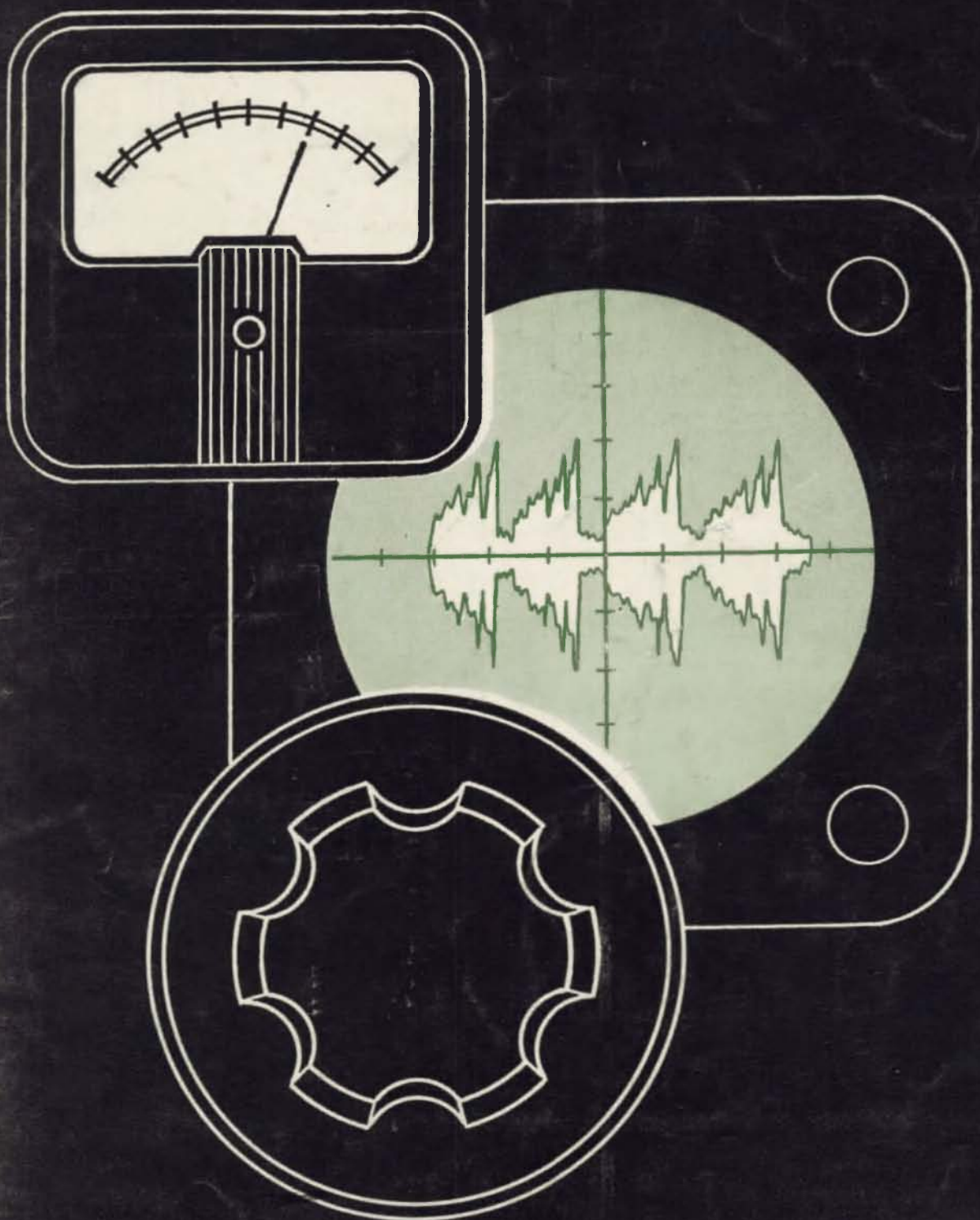
January 1962
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73



73 Magazine

January 1962 • Vol. II, No. 1

1379 East 15th Street—Brooklyn 30, New York

Wayne Green W2NSD—Editor, etcetera

Phone: DE 6-8880

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. . . de W2NSD

. . . never say die

While I must admit to liking being agreed with, there is a negative side to the situation: Suppose I get accustomed to a diet of compliments and shy away in the future from anything that might tend to be irritating? Then where will you be? It gets pretty monotonous every month wagging your head up and down as you read an insipid editorial. Wouldn't you rather run in to the XYL, magazine in hand, and say, "Look what this nut Green wrote this month!"

This is not to suggest that you needle me either, for I can safely brag of some of the most delicate feelings in the entire publishing industry and I may stop writing altogether if attacked. You should always remember that if I chance to write something that you disagree with that I admit that most of the time that I'm talking through my hat and that no one really takes me seriously.

So, in the spirit of fun and irresponsibility let's see where we left off last month.

The November discussion of conventions brought in quite a bundle of mail, and all of it in agreement with my suggestions. Some of them backed up my contentions with facts and figures. I'm not suppressing the opposition, there just hasn't been any.

The December spiking of the anti-communist warmongering of the Anti-Communist Amateur Radio Network snowed me with agreeing letters, official and personal. I was surprised to find so many fellows in high places read the editorial and then put themselves on record that way. It bodes good for the country. Maybe we'll last longer than I think.

Positive action is better than negative. Make it your business, whenever you are in contact with a DX ham or operating where DX hams can hear you, to be as polite as possible. Show an interest in something other than a QSL card. Ask about ham conditions there, and about what he does, etc.

Have you written about the reciprocal licensing bill yet? I hate to be a bore about this, but I *know* what a difference this is going to make when we are back in Geneva discussing ham allocations.

Newsstanding 73

Not being completely content with remaining the third magazine in a three magazine market, we have had visions of improving our lot. The foundation was laid last December when we arranged with a small national newsstand distributor to find out whether 73 would sell on the newsstands. We knew from past experience that the best we could hope for was a 65% sale and that most publishers are quite content with 50%. We offered up 3000 copies a month, not really expecting anything but our worst fears to be realized.

The first issue sold 75%, and from there the percentage rose as high as 92%, averaging about 80%. There was obviously no question about 73 being a good newsstand seller. Next we faced the problem of financing a substantial newsstand expansion. This was difficult for there is a three month wait before any money starts coming back. This is not an inconsiderable figure when you add up the cost of even a cautious start of 20,000 extra copies per month times three. Financing was finally arranged (I watched sorrowfully as K2GZO drove off in my 1959 Porsche).

This step increases our circulation from the present 40,000 to between 55,000 and 60,000, depending upon the newsstand percentages. Such a rise in circulation puts our present ad-

CONTRACT

UNBREAKABLE IRREFUTABLE IRON-CLAD

ALL ye present, be it known that the Undersigned, being of passably sound body, mind and wind, doth this day agree to embark on the profitable practice of peddling his wares, services, or any recognizable agglomeration thereof, in a gazette called "73."

THE publisher of this pot-boiler (sheet), heretofore, herenow, and hereinafter known as Wayne Green, doth assure me that I would be Sorely Vexed, Ill Humoured and Bereft of Reason if I failed to Advertise my sundry wares, services, or any agglomeration thereof in his rag which he describes variously as a Journal of Great and Rare Charm and Refreshing Impertinence. He doth further allege that it has the virtue of having an Abundance of Readers.

BE IT therefore known that I hereby firmly state and attest to my unshakable decision to advertise in said publication, published by said publisher, six or twelve times during the Year of Our Lord 1962 (A.D.), unequivocably. The scrivening proprietor of this sheet piously assures me that the more times my wares are presented in a year, the greater amount of pelf will accrue to me. He also assures me that this agreement cannot be broken unless I Change My Mind, wherein said pelf will quickly unaccrue and serious doubts will be muttered about the editorial offices of said publication as to the continued sound mind of the agree-ee.

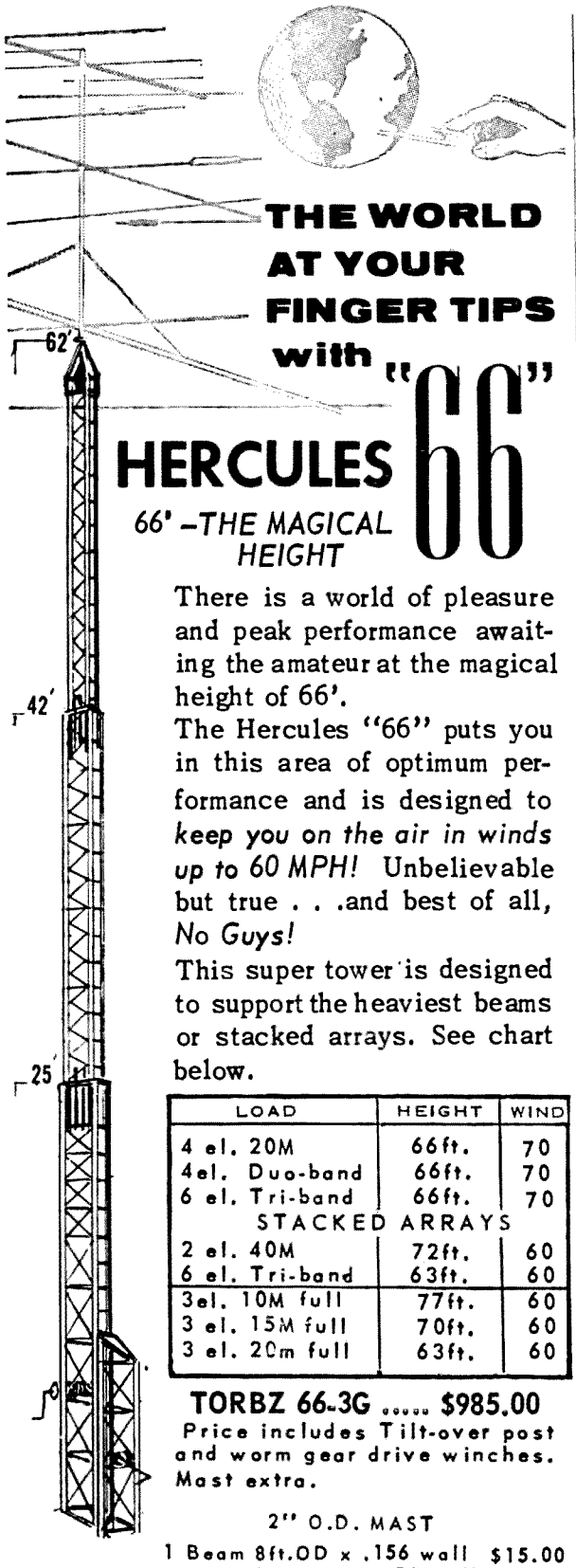
QUAKINGLY, in witness thereof I do hereinunder give my legal signature or mark which shall make this instrument legal and binding on myself and/or the company or corporation which I represent.

Date: _____
(Careful, we have a calendar too)

Signature _____
Pseudonyms will avail you naught.

—— Six times.
—— Twelve times.

Company _____



THE WORLD AT YOUR FINGER TIPS with "66"

HERCULES 66

66' – THE MAGICAL HEIGHT

There is a world of pleasure and peak performance awaiting the amateur at the magical height of 66'.

The Hercules "66" puts you in this area of optimum performance and is designed to *keep you on the air in winds up to 60 MPH!* Unbelievable but true . . .and best of all, *No Guys!*

This super tower is designed to support the heaviest beams or stacked arrays. See chart below.

LOAD	HEIGHT	WIND
4 el. 20M	66ft.	70
4el. Duo-band	66ft.	70
6 el. Tri-band	66ft.	70
STACKED ARRAYS		
2 el. 40M	72ft.	60
6 el. Tri-band	63ft.	60
3el. 10M full	77ft.	60
3 el. 15M full	70ft.	60
3 el. 20m full	63ft.	60

TORBZ 66-3G $985.00

Price includes Tilt-over post and worm gear drive winches. Mast extra.

2" O.D. MAST

1 Beam 8ft.OD x .156 wall $15.00
2 Beams12ft.OD x .156 wall $21.00
3 Beams 20ft.OD x .250 wall $55.00

E-Z WAY TOWERS, Inc.

P.O. BOX 5767 TAMPA 5, FLORIDA

vertising rates into a state of advanced decay, for they are based on 20,000 circulation. With regret we therefore announce a small increase in our ad rates, effective January 1, for all firms not on formal signed contract at the old rates.

Promotions

Some of our promotional ideas have been applauded by the advertisers and I thought you might be interested in seeing some of them. You see, I have to fill in between my monthly cajolling phone calls to advertisers with something to help keep us in their mind. Last year prospective advertisers received a 7" x 10" envelope. The paper inside, when opened up, was 68" x 48" and said in great big letters, "PLEASE FIT 73 IN YOUR 1961 AD BUDGET." We made this by cutting out a stencil the same size as the paper and then spraying paint on press sheets from the printer. The whole operation cost us about $10 for the paint and postage. It was impressive enough so one prospective advertiser said later that he wasn't going to advertise with us because he knew what it must have cost to put out a thing like that and he didn't want to spend his money with people that would waste it.

This year we sent out dart sets with special printed targets. This cost us a little more, but not much. Here, somewhat reduced, is the target.



We followed up the dart game with a special contract form. This was made a little more interesting than the run-of-the-mill contract to point up the new and higher ad rates which go into effect January 1st. The printer had a ball running this one off for us. As a matter of fact, I talked Head Man Hauser into writing the flowery prose for me.

(Turn to page 84)

from davco



Model DR30 Communications Receiver

An outstanding high-performance receiver designed specifically for maximum communications effectiveness in amateur applications. Sensitivity of better than 1.5 uv ; premium RF stage and low-noise mixers produce results comparable to tube-type receivers costing much more. Double conversion: xtal-controlled first oscillator; first (variable) IF at 2.5-3.0 mc.; second IF at 455 kc. for excellent image rejection. Precision tuning oscillator has encapsulated Hi-Q toroidal L components, temperature compensation, amplifier-buffer stage and separate voltage supply for maximum frequency stability. Combination of transformers and ceramic transducer elements in second IF provides excellent selectivity characteristic for hi-fi AM and SSB, easy net operation and, with DQ-1 Q-multiplier, fine CW reception; 2.1 kc. mechanical filter provides maximum usable selectivity for SSB and exalted-carrier AM reception even under the most difficult band conditions. More than adequate audio output for mobile or fixed use. Convenient tuning rate and control arrangement for maximum operating ease and comfort. Provides injection voltages from high (xtal) conversion oscillator and xtal BFO-carrier generator, and mechanical filter, for use with DT20 transmitter-exciter. Reliable high-quality components throughout. Designed to the standards of discriminating SSB operators, yet also the perfect buy for Novice CW and for fixed and mobile AM operation.

DR30 receiver complete with crystals and mechanical filter $289.50

DR30a same as DR30 but less mechanical filter and BFO-carrier generator crystals. Ideal for most AM use and, with DQ-1, Novice CW $229.50

Step-up kit—converts DR30a to DR30 ..... $ 62.00

DQ-1 Q-multiplier unit. Contains effective Q-multiplier, AC supply for DR30, speaker, battery holder for portable use. Thin-line design; may be permanently attached to receiver or used elsewhere $36.00

FEATURES

- covers ham bands 80-10 meters, plus **calibrated** coverage of any three 500 kc. segments for Citizens' Band, MARS, SWL, etc. with accessory crystals or VHF with converter.
- standard-equipment 9.5-10 mc. WWV band also covers popular SWL band.
- built-in crystal calibrator with front panel correction.
- 50 kc. overlap eliminates bandswitching in operating DX portion of 10 meters.
- crystal-controlled **and** variable BFO for upper and lower sideband and for CW reception.
- built-in Conelrad monitor, independent of receiver tuning. Switch selects BC listening and tuning or momentary monitoring of pre-chosen BC station.
- separate diode and product detectors.
- S-meter, AGC; ANL; illuminated dial.
- fully transistorized.
- modular construction.
- American-made.

Size 7½" long, 5" deep, 4" high.

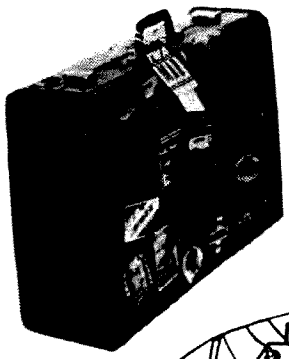
Order today or write for free brochure

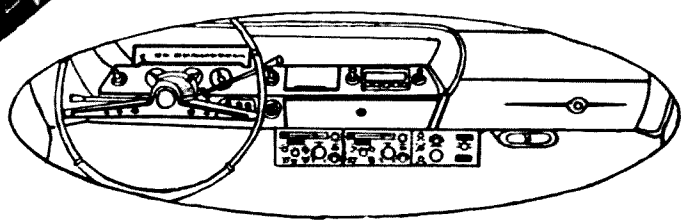
davco *electronics company*

113 Norwood Avenue · **Asheville, North Carolina**

emerging leader in precision communications equipment







The most exciting new product line in years!

Built with extreme precision; designed with space-age techniques. Good basic engineering has combined with imaginative creativity to provide superlative performance, unmatched flexibility, and designs years ahead in concept. The davco units are a joy to own, a proud investment and effective communications devices. Conceived and produced with one goal: to provide the best and most versatile equipment available, specifically for use by amateurs in today's amateur bands.

Davco DT20a SSB exciter-transmitter

Fully bandswitching, capable of approximately 20 watts SSB output, 8 watts AM. Ideal for portable or mobile operation or driving higher powered linear amplifier. Uses 2.1 kc. mechanical filter for maximum sideband suppression; carrier suppression of 40 db or more. Built-in VOX; speech processing for increased talk-power. Uses minimum of operating adjustments while retaining maximum application flexibility. Separate compact AC and 6-12 volt DC supply. Designed to complement the Davco DR30 receiver in every respect. Separate VFO, or Transceiver operation with frequency control from DR30 receiver when desired. Sideband generation at 455 kc. An extremely versatile, advanced-design unit built to the same standards as the DR30. Provides a clean emphatic signal which assures good communications from home or car, or while traveling. Transistorized; tube-type final. Available January 1962.

DT20a complete exciter-transmitter $345.00

DT20 exciter-transmitter. When used with DR30 receiver, provides all functions of complete transmitter including independent VFO frequency control, but uses mechanical filter, carrier generator, and high frequency conversion oscillator of receiver $215.00

Davco DA100 linear amplifier

The DA100 linear amplifier, when driven either by the DT20 or by the DT20a, provides approximately 120 watts SSB or 50 watts AM. Like the DR30, the linear amplifier is designed for mobile, home station or portable operation and is built to the highest performance specifications. Available February 1962 Price to be announced.

Complete Station

A complete station consisting of the DR30, DT20 and DA100 provides 120 watts of SSB and 50 watts AM on all bands 80-10 meters; dual or transceiver frequency control; VOX operation; highest quality receiving performance; many other features for less than $700. It may be purchased all at once or you may replace your present station a unit at a time. When used for mobile operation, battery drain for the amount of output is at a new low & your passengers will appreciate the small size of the units. Fits even compact and imported cars. For DXpeditions, college, hotel or resort use the high performance and sturdy construction make the Davco units your most logical choice For home station use, the attractive styling, pleasant grey-black color scheme, and small dimensions of the combination permit use in rooms where older, more bulky equipment is undesirable.

Davco guarantees the workmanship and components of its units for a period of one full year See brochure for complete guarantee.

Write for complete brochures giving fully detailed information on the DR30 and on other units as they become available. Time-payment information sent on request. Prices, finishes and specifications subject to change without notice or obligation.

Dial (Area Code 704) 253-8340

davco *electronics company*

113 Norwood Avenue · **Asheville, North Carolina**

Kilowatt SSB Transceiver

Paul Barton W6JAT
14666 Berry Way
San José, California

ABOUT two years ago Jo Jennings W6EI and his gang,[1] began work on a transceiver. Numerous models were built and tested including a transistorized model, all with a somewhat similar basic idea. This idea appears to have germinated somewhere between Jo Jennings and Don Johnson. At one time, Denny Moore put a fine printed circuit board kit on the market as an aftermath of this same project. His interests have since been sold to a manufacturer.[2]

The transceiver presented here was one of the inbetween models and was designed and built by Rudy Stefenel, W6QW. While Rudy was off finishing up his college work, the unit was slightly modified by Bert Newkirk, WΦRYG/6.

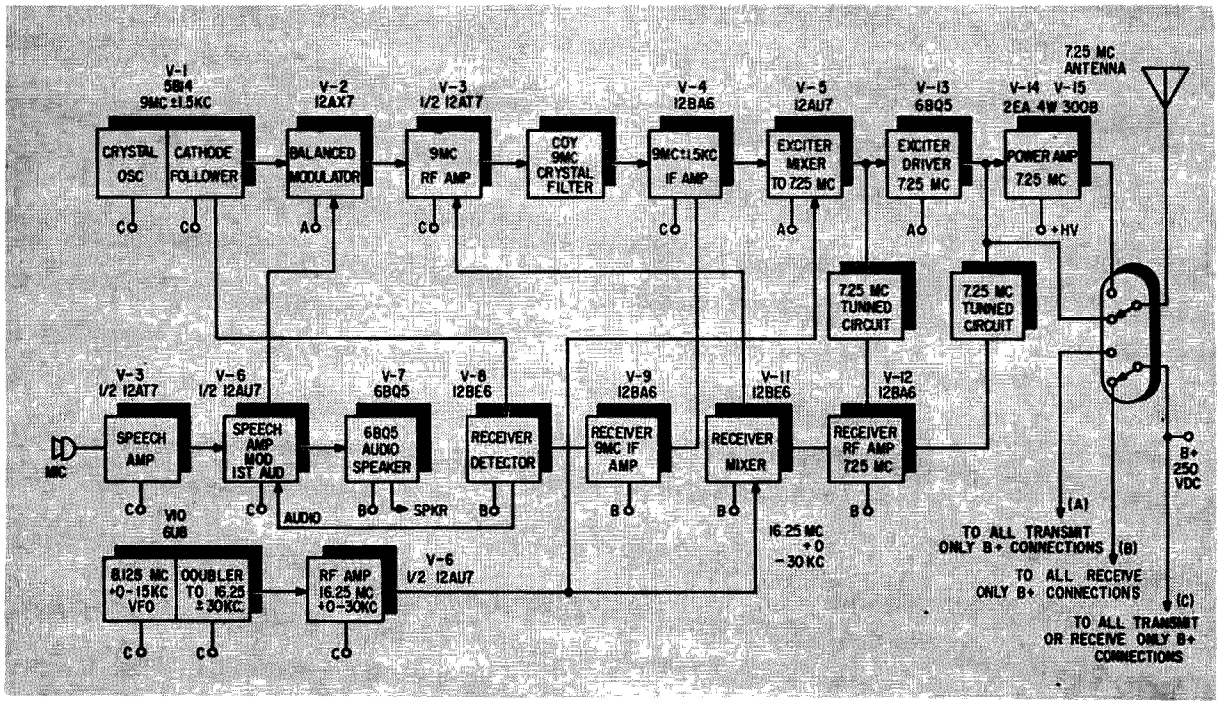
This unit, although a prototype, is a working model that has seen quite some hours of successful service on the air.

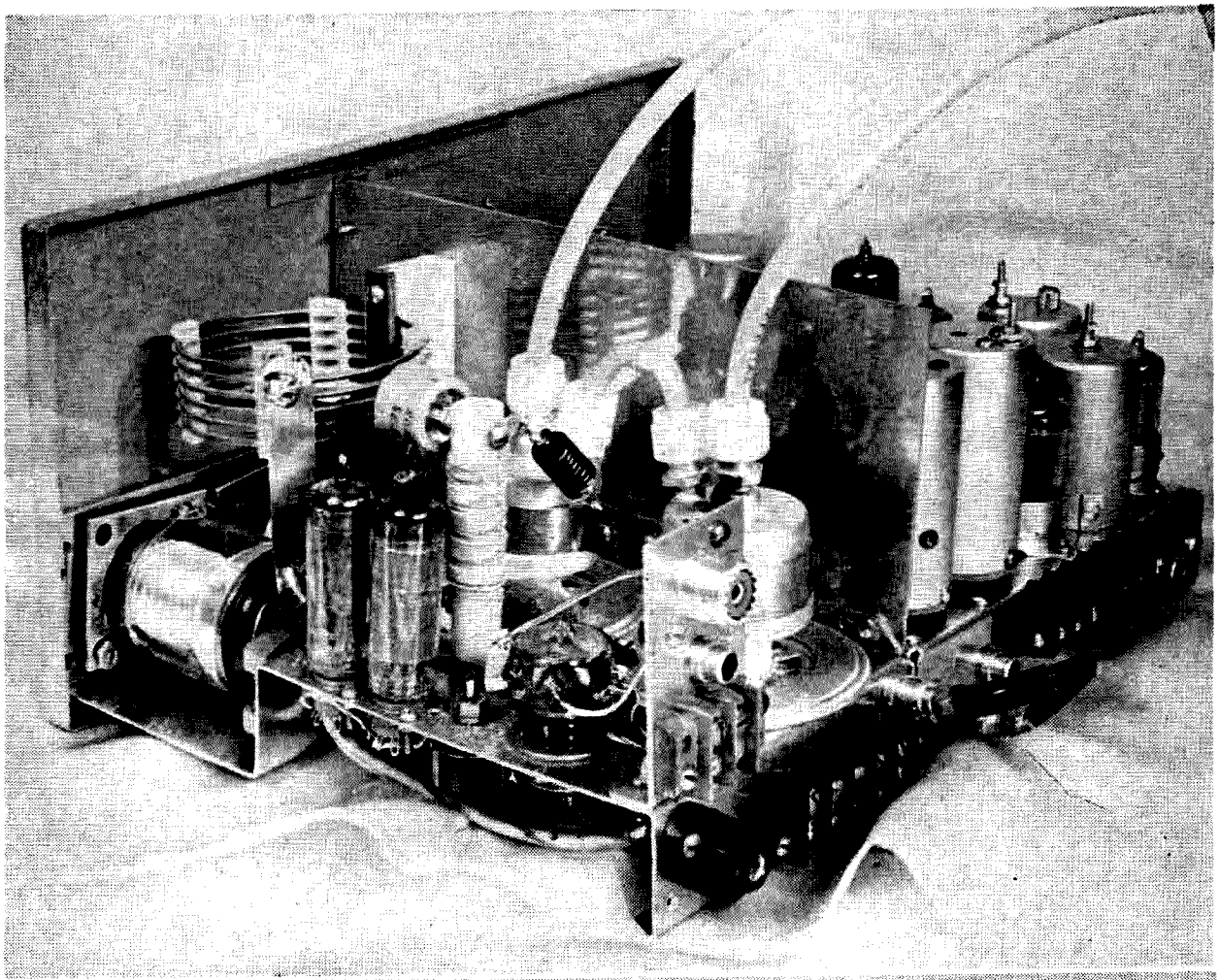
This transceiver was tailored for a specific job, forty meter mobile, which simplifies things somewhat by not requiring bandswitching or even a wide frequency coverage within the band.

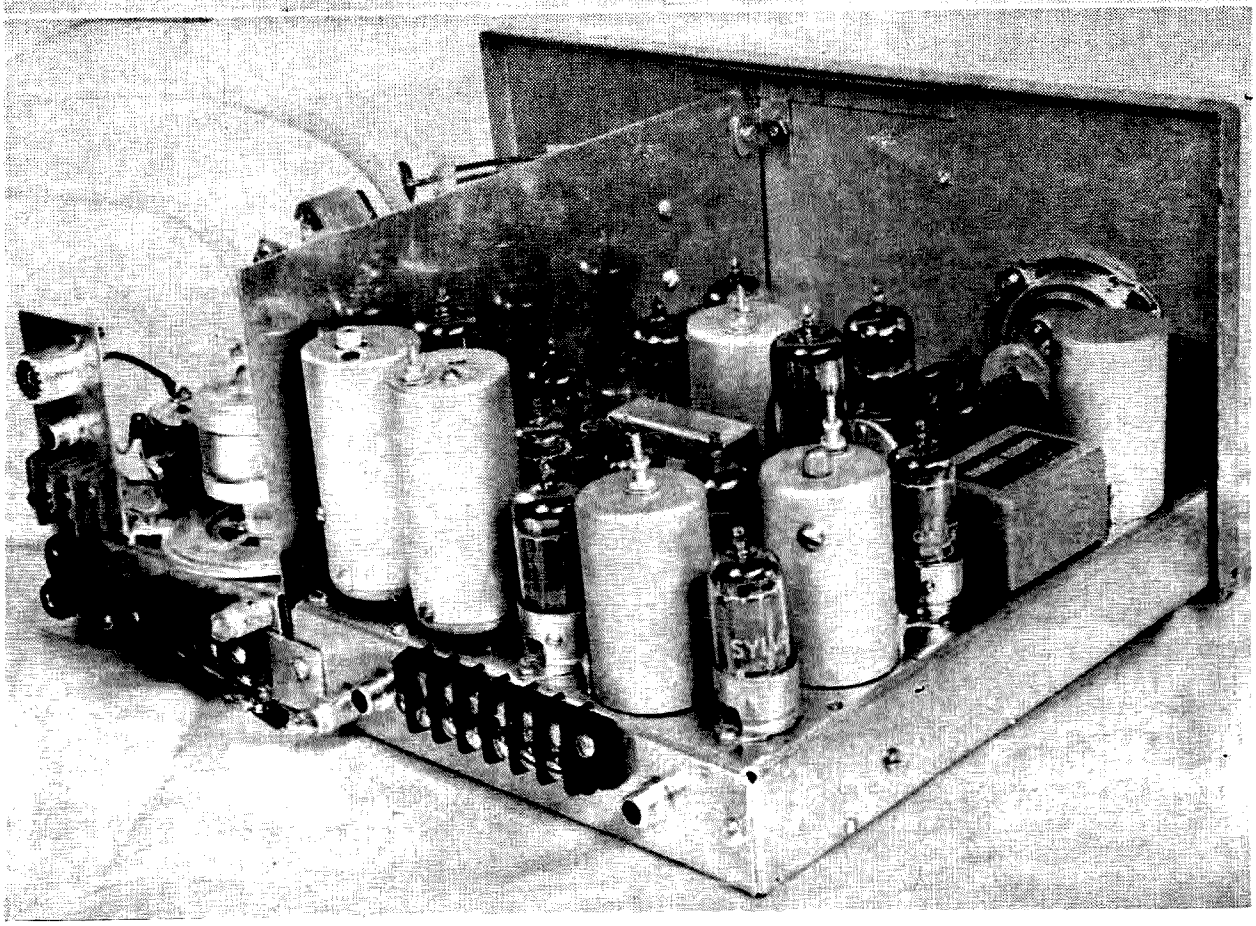
The filaments are connected for 12 volt operation, but the unit could be modified for 6 volt filament operation easily. It is meant to be operated from a 12 volt transistorized kilowatt power supply, and thereby makes a very neat compact and highly effective mobile installation.

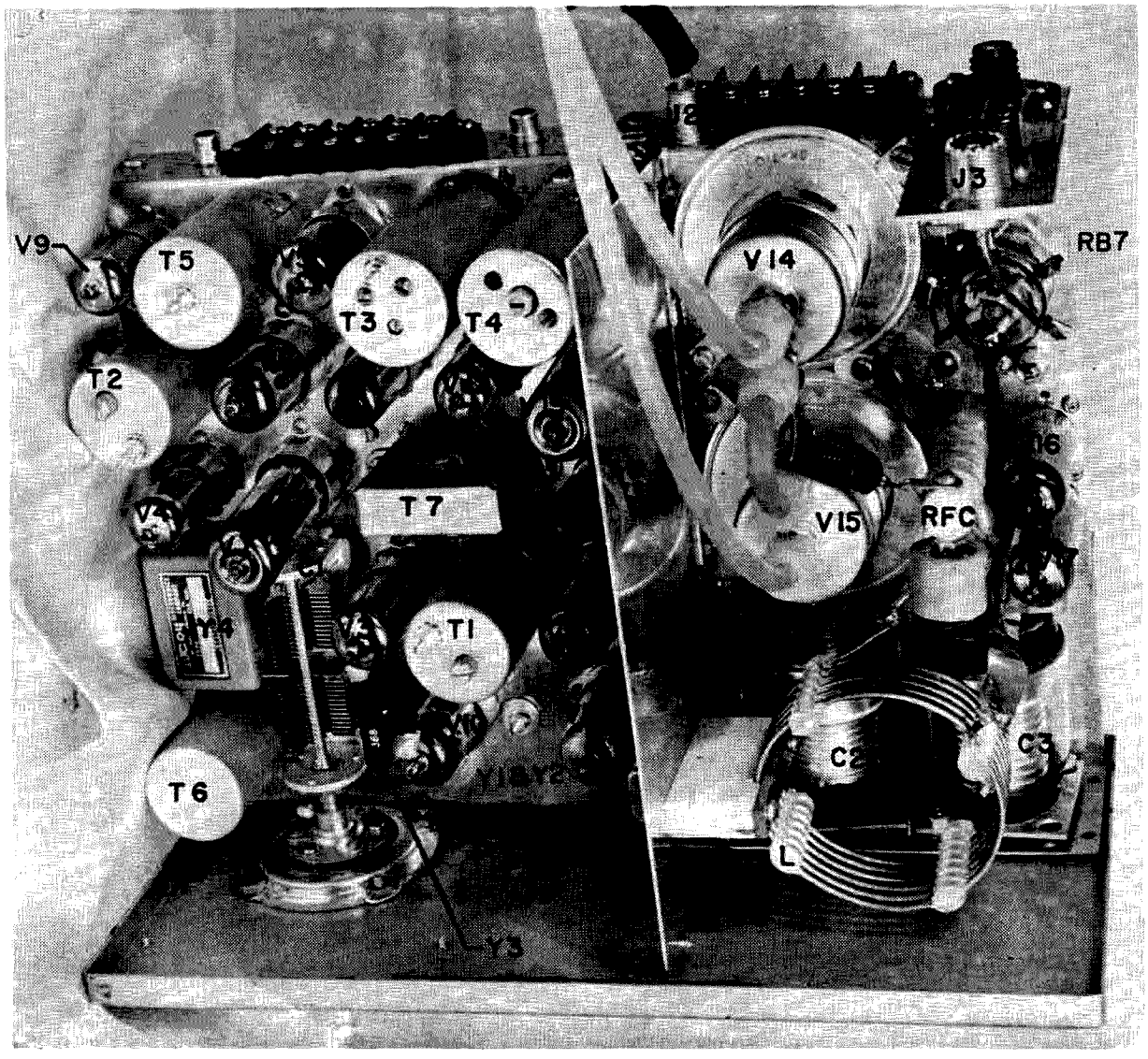
The receiver is surprisingly sensitive and selective. The selectivity is obtained by the crystal filter. This transceiver uses a McCoy crystal filter. (See McCoy ad, page 30.) There are several excellent articles on crystal filters available.[3]

The sensitivity is partially the result of a simple circuit, including what could be called single conversion. Converters are noise generators so, although necessary, the fewer the better for low noise level. Band switching and moving parts such as tuning condensers can easily generate noise, so eliminate them if possible. This transceiver is only meant to cover 20 kc, so only the high frequency oscillator is variable from the panel. All other tuning adjustments are set and left alone.









The high frequency oscillator is common to both transmitter and receiver. It is a "rubber crystal" circuit, good for 10 kc variation. The rubber crystal gives sufficient stability for mobile single side band work. The transceiver covers 30 kc in the 40 meter band.

The transmitter is a 9 mc crystal filter rig ending in a conservative KW of SSB power.

The final has two 4W300B, Eimac water cooled 4X250B tubes. Eimac also makes this tube with a 12 volt filament.

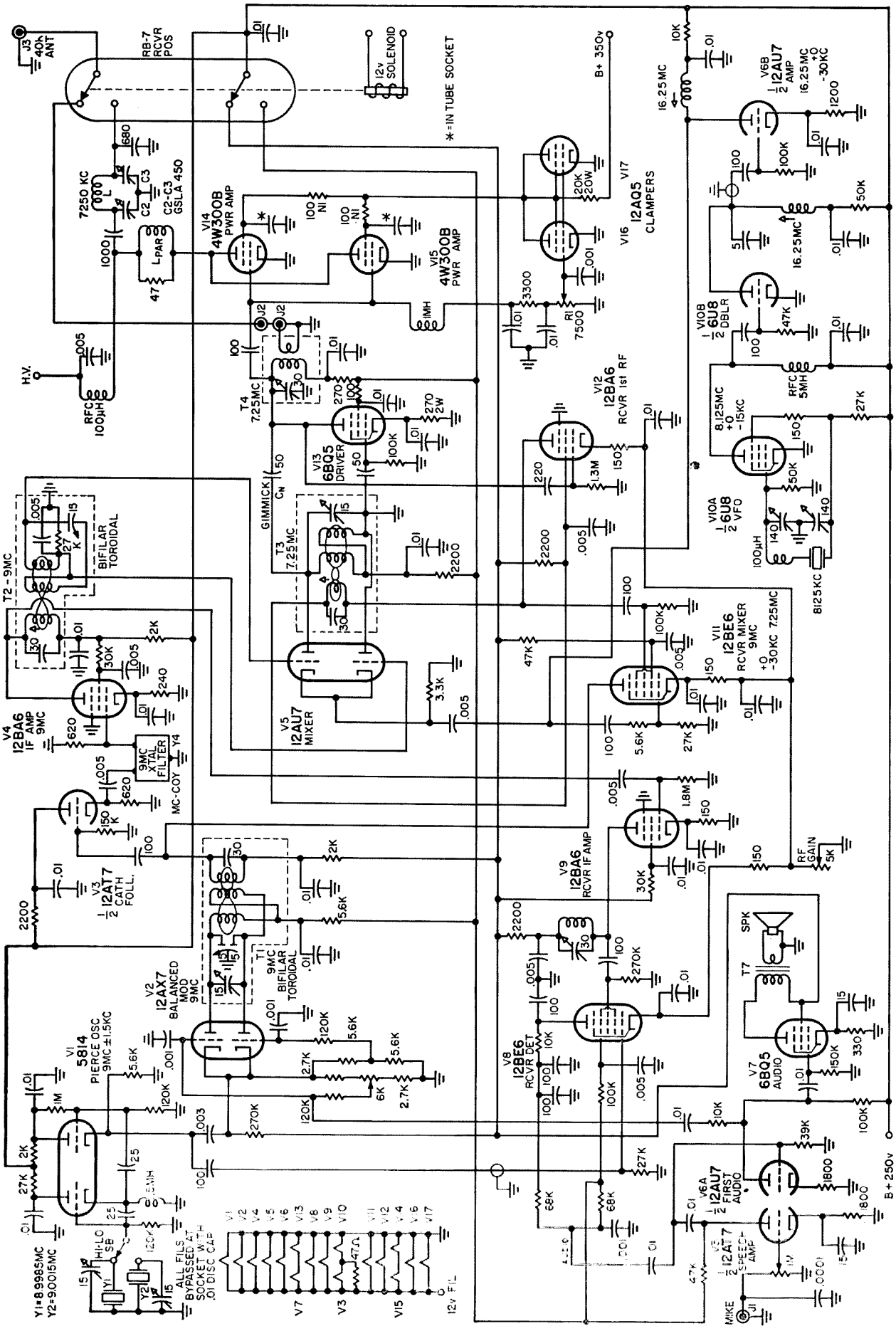
The water cooling is normally taken care of with a gallon copper tank and an electric fuel pump.

The T-R switch transfers the antenna from receiver to transmitter and simultaneously switches the plate voltage from the receiver to the exciter. It is a Jennings DPDT RB-7 vacuum switch.

Referring to the block diagram, thtre is a tuned circuit between the driver (V-13) and the final that is also used as the input tuned circuit of the first rf amplifier of the receiver (V-12). Likewise there is a common tuned circuit that tunes both V-13 input or V-11 input. Using coils common to two circuits saves space and works satisfactorily. Also, if it is desired to change bands, a pair of plug-in coils at this point would change the entire exciter and receiver to another band. Of course the final tank coil would have to be changed also. If space is not as important, separate coils for transmitter and receiver circuits could be used here.

7.25 mc signals from the antenna go through the 1st rf amplifier (V-12). Then it is mixed with the 16.25 mc VFO voltage in V-11 to an *if* frequency of 9 mc and amplified and filtered through the *if* amplifier tubes V-3 and V-4, and the McCoy 9 mc crystal filter. After further amplification at 9 mc through V-9, the signal is detected to audio in detector V-8. V-8 receives a heterodyning signal from crystal oscillator and cathode follower V-1 that is 1.5 kc either higher or lower than *if* frequency according to whether it is high or low sideband to be received. Then the audio signal is amplified in V-6 and V-7 to loudspeaker volume.

The SSB exciter begins with a 9 mc plus


J3 40m ANT
RB-7 RCVR POS
12v SOLENOID
* = IN TUBE SOCKET
B+ 350v
7250 KC
C2-C3 GSLA 450
V14 4W300B PWR AMP
V15 4W300B PWR AMP
V16 V17 12AQ5 CLAMPERS
V6B ½ 12AU7 AMP
16.25MC +0 -30KC
V10B ½ 6U8 DBLR
V10A ½ 6U8 VFO
V12 12BA6 RCVR 1st RF
V13 6BQ5 DRIVER
V11 12BE6 RCVR MIXER 9MC +0 -30KC 7.25MC
V5 12AU7 MIXER
V4 12BA6 IF AMP 9MC
V3 ½ 12AT7 CATH FOLL.
V2 12AX7 BALANCED MOD 9MC
V1 5814 PIERCE OSC 9MC ±1.5KC
V9 12BA6 RCVR IF AMP
V8 12BE6 RCVR DET
V7 6BQ5 AUDIO
V6A ½ 12AU7 FIRST AUDIO
V8 ½ 12AT7 SPEECH AMP
T1 9MC BIFILAR TOROIDAL
T2 - 9MC BIFILAR TOROIDAL
T3 7.25MC
T4 7.25MC
T7 SPK
9MC XTAL FILTER Y4
MC-COY
Y1=8.9985MC
Y2=9.0015MC
HI-LO SB
ALL FILS BYPASSED AT SOCKET WITH .01 DISC CAP
12v FIL
MIKE
B+ 250v
H.V.
RFC 100µH
RFC 5MH
8.125KC

or minus 1.5 kc crystal oscillator. High or low sideband is selected by the crystal here. This signal is fed into the balanced modulator V-2, which is modulated with the speech amplifier, ½ of V-3 and ½ of V-6. The output of the balanced modulator is double sideband suppressed carrier, which is fed into the 9 mc amplifier, ½ of V-3. Then one side band is filtered out in the McCoy crystal filter and further amplified as SSB voltage through V-4. The mixer V-5 converts the 9 mc *if* signal to output frequency 7.25 mc, with the 16.25 mc voltage from the VFO, and its doubler (V-10) and amplifier ½ of V-6. The output of the mixer V-5 is amplified through the driver stage V-13, then further amplified through the power amplifier V-14 and V-15.

The final is a conventional class B clamp tube linear. This type linear has proven to be nearly as linear as a good triode type amplifier and much easier to drive.

The amplifier's static linearity is adjusted at R_1. Connect a 45 volt battery across R_1 with a switch or key in series with the battery. Apply plate and filament voltage to the amplifier. No excitation. Observe the plate idling current of the final amplifier. Key the battery across R_1 and adjust the arm of R_1 until the plate current remains the same with or without the battery across R_1. Now the clamp tube will be releasing screen voltage to the final so as to keep a constant ratio of screen grid voltage to fixed bias voltage.

The clamp tube linear amplifiers are somewhat self limiting in plate power if the load is not sufficiently heavy, or if over excited. Under this condition the tube will draw screen current and drop the screen voltage which in turn limits the plate current, and saves the tube from being destroyed. However, it will distort.

A screen current meter is useless in this type circuit. A screen voltmeter should be used instead. As excitation is increased, the screen voltage (and plate current) will increase to the point of limiting. Adjust load and excitation until proper plate current is obtained at the point of limiting. Check for efficiency. It should be not less than 65% at point of limiting. Improper setting of R_1 will result in poor efficiency.

The input and output condensers of the pi net of the final amplifier are Jennings Type GSLA 45Φ. The 68Φ mmfd padding condenser across the output condenser C_3 is a mica. The plate rf choke is wound on a half inch diameter insulating rod (fiber glass, in this case) of #26 manganan resistance wire.

RF transformers T-1, T-2 & T-3 are torroidal bifilar wound shielded transformers. They are wound on powdered iron torroid forms from Arnold Engineering Company. The primary of each transformer is link coupled to the secondary. The added tuned circuit give better selectivity.

The VFO coil T-6 is a critical element. A quartz crystal has the electrical equivalent of a large inductance in series with a small capacity. These two are series resonant at the crystal frequency. By adding inductance in series with the crystal, the frequency of the crystal may be lowered. But this added inductance must be high Q, and the crystal must be very active; otherwise the crystal will lose control and the oscillator will be self excited. This oscillator can be moved more than the 15 kc shown, but the further it is moved, the more it has the characteristics of a self excited VFO instead of a crystal controlled oscillator.

The tube line up and circuit of the VFO, doubler, and amplifier, bring up a large question mark to an experienced eye. However, many hours and much changing of arrangements were done before this was settled on. The best proof is that it works. . . .W6JAT

---

[1]Don Johnson, W6AAQ; Rudy Stefenel, W6OQW; Dick Currell, K6IHS; Denny Moore, W6MHP; and several others.

[2]Cabral Motors, Inc., 51 Victory Lane, Los Gatos.

[3]QST Jan. 1961, Surplus Crystal HF Filters.

QST Jan. 1959, Mobile SSB Transceiver.

QST Mar. 1960, SSB Exciter Circuits using beam tube 7360.

QST Oct. 1960, Hi Freq. Crystal Filters SSB.



Lifer No. 6

Dear Wayne,

You would be happy to learn that as Lifer Number Six, you have awarded a life subscription to a 73 year old steeplejack presently under contract to install TV antennas on the Empire State Building, and who is better known in the trade as "No Belt Johnston," and finally who has not had a heart attack in the last six months.

Unfortunately this is slightly in error as I'm presently 27, and rarely climb my 60 foot tower. I became interested in Ham radio while studying at Yale University and received my ticket soon after graduation while in the Air Force. I am active on 2 thru 20 meters using partially home-made and partially commercially made equipment.

As a rated FAA Commercial Pilot I believe that I qualify for your requirement as a test pilot, because every flight is a test to see what happens when I hit the ground in what is known as "a controlled crash."

Dick Johnston K1QJD

Rotate that Tower

W. S. Baker K2LZF
Box 291, R. D. 1
Greenfield Center, New York

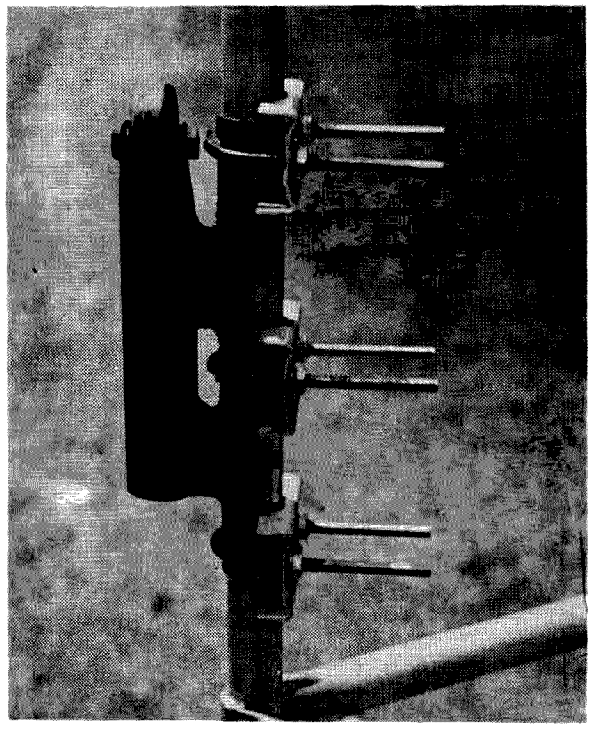
Photos by Edward Valmare K2EVJ

FULL utilization of a tower is realized only when the entire structure is rotated. When the tower is rigidly guyed it is necessary to place all antennas above the tower on rotating tubing. This limits the number of antennas which may be put up and places great demands on the tubing and rotator. To avoid these problems and allow stacked antennas, large H-frames, etc., the obvious answer is to rotate the tower. Impossible, you say? It might seem so, but like most antenna projects it is easier than you first think and becomes easier in the doing. If you do some scrounging and rigging you can rotate that presently inert tower.

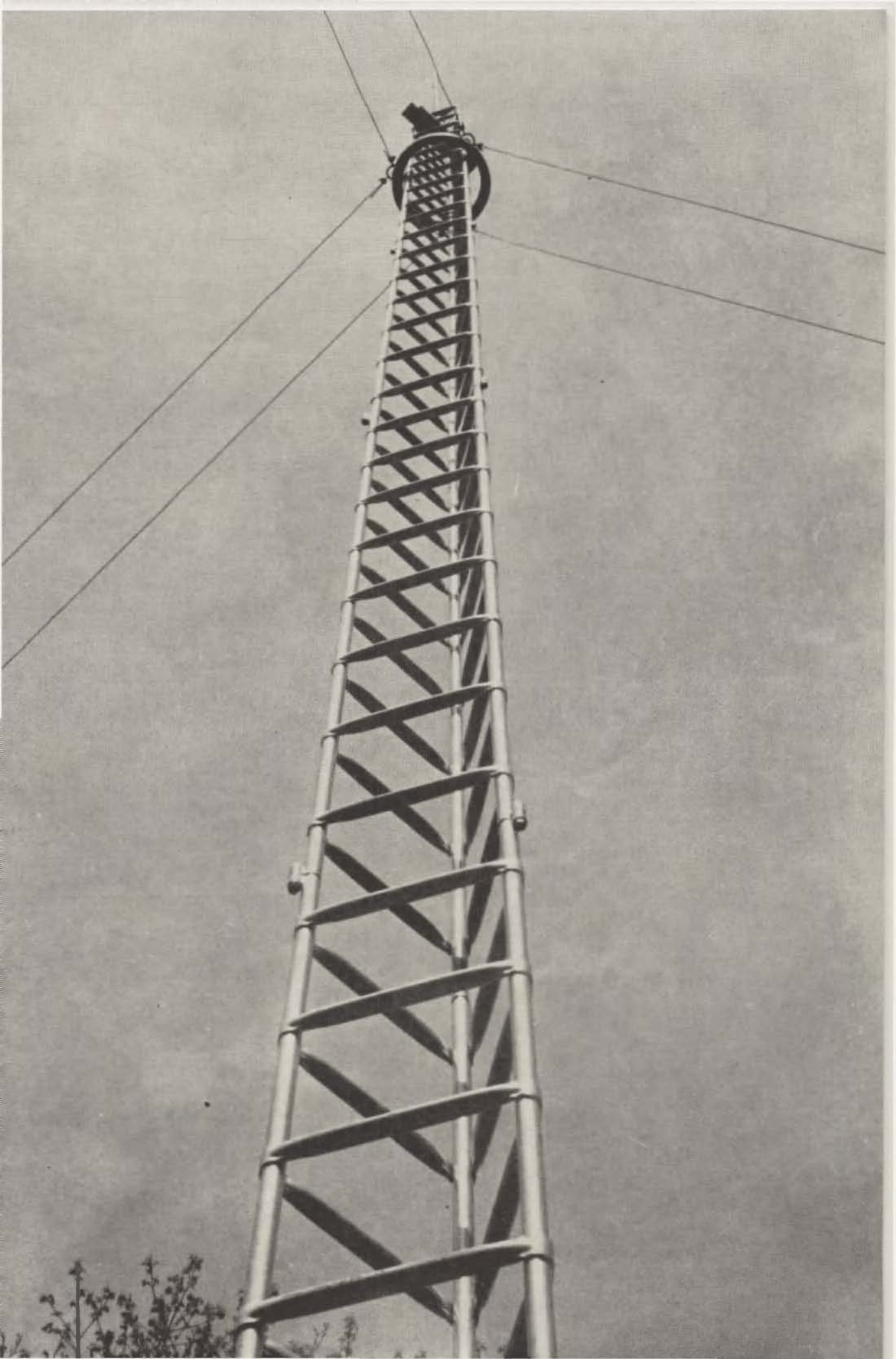
There are two ways to execute any project of this sort: You can engineer the dickens out of it, make engineering drawings, and add tolerances. It will cost like it too. Alternately, you can fashion it, and diddle as the project evolves. This latter method is the one expounded here, and is the only practical one for the individual with limited resources. In line with this attitude, this article should be read for ideas, with copious references to the pictures. This will not be a description blueprinted down to the last measurement, since your attempt will bring to the project different skills and sources than did mine.

The project divides itself into three parts for consideration: 1. The rotating base, 2. the rotating guy ring, and 3. the wheel holders which attach to the tower. The principle is to guy to the ring in which the tower runs on roller skate wheels. The rotating base is the pinion bearing housing from an old car. A





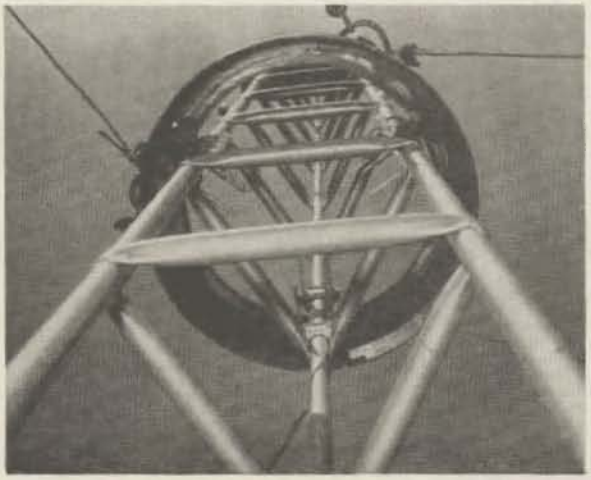
1955 Mercury rear end was used here; you use what you can find. In the course of operation of a car this bearing is subjected to tons of force applied in the same manner as the tower bears on it here. The tower's weight appears modest by comparison. The base of the tower was modified to run on the bearing by welding the three legs to a piece of boiler plate. The tower legs should be kept open to the bottom to allow moisture to escape. The center of the bottom of the flat base was determined, and two concentric pieces of pipe were welded into place. The inner, smaller piece of pipe goes through the pinion bearing to keep the tower from hopping off the base. The larger, outside piece of pipe is selected to run on the face of the bearing. A bicycle sprocket is brazed onto the outer pipe just below the boiler plate tower base. The rotator, a prop pitch motor, also has a sprocket welded to it, and the tower drive is applied through bike chain. The prop pitch motor has its own mount off to one side of the bearing base. The bearing base is set several inches in concrete with threaded rods screwed into the tapped holes in the frame. These project several feet down into the body of the concrete.





The guy ring was made from a five inch high, eighteen inch diameter section torched out of an old hot water boiler which was selected for minimum internal wall pitting. This gives you quite a good circle which your welding source would be driven to distraction or high prices to fashion from flat stock. A top rim was welded into place, leaving a fourteen inch hole for the tower to project through. The inside of this face is the running surface for the roller skate wheels. I suggest that all welding of the ring be done by the electric arc process. It heats the material adjacent to the weld less, and leaves it stronger and less deformed. Small loops of steel rod were bent into loops and the ends welded to the top surface of the ring. These are the guy points.

To allow flexibility and to avoid weakening the tower, the wheel carriers were not welded to the tower. Three roller skate wheels mounted in fixtures which clamp to the vertical legs take up the vertical component of force. A set of wheels running in the horizontal plane to take up this component was not used in the interest of simplicity. As long as the guy angles are reasonably flat this simplification does not seem to be harmful. The horizontal force bears on the bolt heads which hold the roller skate wheels in their carriers. The rubbing of these bolts against the inside of the ring might make necessary their replacement every few years. Even so the tower runs quite freely with very little binding as long as the guys are kept somewhat loose. They tend to grow taut in cold weather.



The actual wheel carriers are made from slotted and halved pieces of electrician's metallic tubing (E.M.T.). The portion of the holder which is clamped to the tower leg is half circle of one inch diameter e.m.t. with television U-clamps brazed to it to go around the tower leg. The wheel holder itself is a short length of tubing cut out at one end to allow insertion of a roller skate wheel. The tabs left after the cut-out, or ears, are drilled to hold the bolt which is to be the axle for the roller skate wheel. Short pieces of e.m.t. are hammered into ovals and then brazed into place between the carrier and the tower clamp to complete the assembly. Washers placed between the bolt heads and the wheel holder can serve to take up the distance between the bolt head and its running surface, the inside of the ring. A gap of at least one quarter of an inch should be left between the bolt heads and the ring to allow easy rotation. The bolts used should be good quality steel. The entire wheel carrier assembly is brushed to remove the borax residue of the brazing process, and the entire fixture is given a coat of rust inhibiting paint.

The tower was erected with several sets of temporary guys, and then the wheel holders and rings were installed. Notice the six guy principle used to keep the ring from turning as the tower rotates. When completed, the rotating tower stands ready to have antennas sprinkled up and down it. Credit for the basic concept of tower rotation presented here goes to Jud, K2CBA. . . . K2LZF

Letter

Gentlemen:

I always like the "Staff" articles as they are informative and often call attention to some idea that was presented in a book or periodical not available here unless it gets purchased. Heaven forbid that. I am magazine poor already.

I was very much interested in the new mixer circuit presented in 73 for Oct. '61 on page 32. I must admit I was quite dubious about it but I went ahead and changed my 75A4 1st mixer to a 6BK7B using the idea presented in the article. My voltages were 250 and 75, with a cathode resistor of 100 ohms. The new mixer was quieter, and had more gain according to the s meter and signal calibrator. I estimate at least a 10 db gain over the 6BA7, with a lower set noise.

I do not anticipate changing the 2nd mixer as the 6BA7 circuitry gives a handy method of controlling the set gain independently of the IF stages, and besides, the 2nd mixer isn't very noisy.

To say I am pleased with this new mixer, would be an understatement.

M. C. Smith W6GMC



There is no difficulty in reading the meter of this compact instrument.

73 Tests the Alco GDM-1 Grid Dip Meter

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

"Q" meter, L-C meter, crystal activity tester, HF-VHF signal generator, field strength meter, modulation quality checker and absorption wave meter. . . . If this sounds like a whole lab full of equipment, then wait one. This is only a partial listing of the functions that a good grid dip meter will perform and we haven't even touched on its primary area of usefulness, that of determining the resonant frequency of "cold" tuned circuits and antennas.

However, the ALCO Model GDM-1 grid dip meter is a cut above other equipment in its price range; that is if you can find one to compare it with. This is a completely wired, tested and calibrated instrument which sells for $36.95, amateur net. Features not found in some other instruments include internal AM modulation, color coded dial and coils, adjustable index for precise calibration and a large, easy to read, plastic case meter. How come all of this for $36.95? Well, it is an imported instrument, made in Japan, and is being sold as a direct mail item by ALCO Electronic Products, Inc. of Lawrence, Mass.

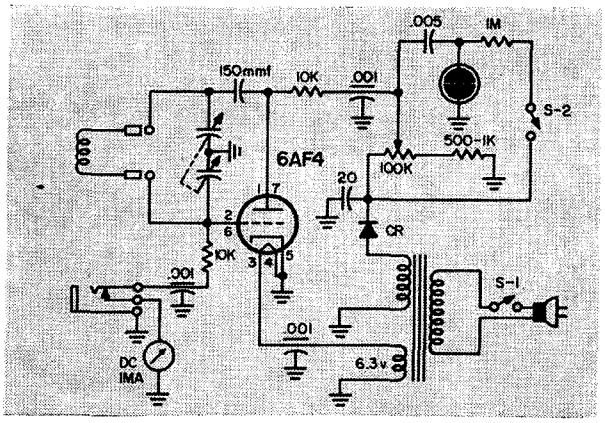
The GDM-1 covers the range of 1.5 to 300 mc using 6 sturdy, color coded coils which plug into a standard crystal socket mounted on the front of the case. The coils are stored in a cushioned, heavy plastic box. The instrument is housed in an attractive, heavy gauge brushed aluminum case measuring 6½" x 3¼" x 1½". The case has a substantial heft and a nicely shaped for easy one hand operation. Control designations are neatly silk screened for ready identification. Hardware is nickel plated brass and machine screws are used instead of the sheet metal screws often encountered in lower priced equipment.

The six color coded scales are nicely laid out on a 3" diameter, serrated edge, plastic dial and an adjustable index scale is provided for precise calibration of any given range. The dial mechanism includes a friction device for smooth operation and the dial extends beyond the right side of the case for easy, vernier effect, tuning.

Internal AM modulation is provided and may be selected by a slide switch mounted on the back end of the case. This feature simplifies use of the instrument as a signal generator. The tone is rich in harmonics and enables identification of the grid dip meter signal in a welter of heterodynes. A phone jack is provided for monitoring purposes and good results are obtained with the instrument in either the oscillating or non-oscillating mode.

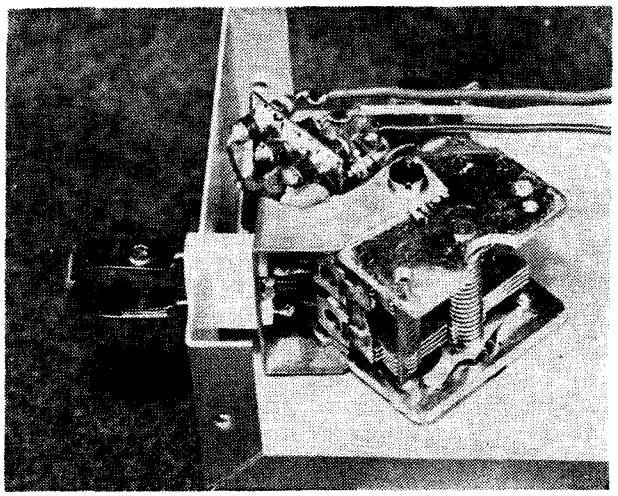
Study of the schematic diagram will disclose nothing really new in circuitry, although the AM modulation capability is an additional and very useful feature not found in many other instruments. The circuit is a conventional ultra-audion oscillator using a split stator tuning capacitor. A milliameter is connected in the grid circuit and the plate voltage is made adjustable to control the magnitude of oscillation. This permits setting the grid current to the optimum point on the meter scale. When the grid dip meter coil is coupled to a circuit tuned to the oscillator frequency, it will absorb power. This loss of energy results in a decrease in the magnitude of oscillation and is indicated by a reduction in grid current. Therefore, by tuning the instrument for a dip on the meter and reading the frequency from the dial, the resonant frequency of the external circuit is quickly determined.

The modulator uses a neon lamp in a relaxation oscillator circuit and produces a pleasing tone. The power supply is conventional, using a selenium rectifier with a line isolation transformer and a 20 mfd filter ca-



pacitor. This simple circuit reduces hum to an acceptable level. The requirements placed on the meter used in a grid dip meter are quite demanding. The meter pointer should not shift with rapid changes in position or orientation but, at the same time, should respond quickly to small changes in current. In the GDM-1, the movement characteristics seem ideally matched to the requirements of the instrument and the large plastic case meter with its white on black scale is easy to read from all angles.

Performance of the GDM-1 leaves little to be desired. The thin profile of the instrument case, coupled with the "long reach" coils that are used on all execpt the highest frequency band, makes it easy to get into inaccessible areas. When the instrument is grasped in the hand, the serrated frequency dial falls under the thumb for easy adjustment and true "one hand" operation. The most outstanding feature



The secret of the outstanding performance of the instrument is in this well engineered oscillator assembly.

of the ALCO instrument is the absolute freedom from spurious responses. Also, with the exception of the lowest frequency range, grid current is uniform across the dial. On the lowest frequency coil, there is a gradual falling of grid current as the low end of the dial is approached.

The secret of this performance is shown in the close-up photo of the rf section. All circuit elements are constructed as a compact sub-assembly which results in essentially zero length leads. RC filters using ceramic feedthrough capacitors give extremely good circuit isolation of all external leads. The effectiveness of this decoupling is enhanced by the use of a copper plated sub-assembly chassis which gives low resistance grounding of the critical circuit elements.

The instrument gives good performance as a crystal activity checker and as a crystal controlled signal source. Crystal activity is indicated on the meter. Crystals from 200 kc to 20 mc were tested and all oscillated strongly. This and many other applications, including those listed in the lead paragraph, are covered in the instructions. The "Mimeographed in Japan" instructions will get plenty of use and really should be published in more permanent form. Those interested in pursuing the subject further are referred to the excellent book, "HOW TO USE GRID DIP OSCILLATORS," by Turner. This book is available from 73's own Radio Bookshop for a nominal $2.50.

In the instrument tested, no deficiencies were noted which affected the performance. One point, however, deserves mention and possible correction in production. In all except the RF sub-assembly, which is excellent, the assembly and wiring techniques are slightly below commercial instrument standards. This is a minor point but a couple of terminal strips, a foot of lacing twine and ten minutes longer on the production line would turn the present aggregation of lead mounted components and point-to-point wiring into a "MIL Spec" creation.

Without a doubt, the ALCO GDM-1 grid dip meter is a bargain on todays instrument market. The GDM-1 should have considerable appeal to the amateur who likes his test equipment factory wired and calibrated. Even if you construct no equipment, the utility of a grid dip meter in antenna and trap adjustment more than justifies the purchase. In addition, you as the proud owner of a shiny new instrument will find you have friends you never knew you had. . . . W4WKM

Photo: Morgan S. Gassman, Jr.

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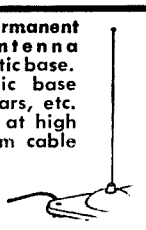


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Bill Ashby K2TKN
Director of Service Engineering
Cornell Dubilier

Rotors

ONE beneficial effect that TV has had on amateur radio has been to provide several good brands of antenna rotors at reasonable cost. As Director of Service Engineering of one of these companies, I have seen the amateurs adapt these units successfully into a service for which no thought was given during design. All successful TV rotors have been developed to orient a TV antenna and to be produced in large volume at the lowest possible cost—period. The fact that tens of thousands of these rotors are in daily use by amateurs, twisting the tail of tri-banders, quads, VHF Christmas trees, etc., is a verification of their ability to increase the usefulness of a product far beyond the imagination of the original designers.

This brings up an important point. Letters of inquiry from amateurs to manufacturers about such products fall into two broad categories—first, those who commend our design and suggest that we incorporate certain improvements in future productions—second, and by far the majority, those who loudly proclaim our incompetence in design, manufacture, advertising, distribution, etc.; for they can see some deficiency from the ideal in their rotor system operation. To my knowledge, no reputable TV rotor manufacturer has ever claimed that their TV rotors would be entirely suitable for amateur usage, yet somehow many purchasers feel that a manufacturer of a product must make provision to individually custom design the entire antenna-rotor-tower system, insure trouble-free operation, and outperform all competitive products.

As a manufacturer, I should answer this type with a form letter stating that the product was not designed for this usage, but as an amateur and knowing of the multitude of highly successful installations by others, I can only stack up this mail and answer each as best we can, passing along a hint or kink developed by another amateur for this product.

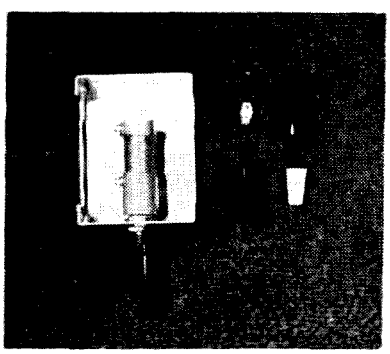
The assumption by many that a manufacturer knows more about his own product than anyone else is based on wishful thinking. A manufacturer knows how to build and sell—only the satisfied customer knows that product's best usage and limitations. The fact that you paid $36 for a CDR AR22 rotor does not mean that you must keep it a deep-dark secret that it goes out of sync when the wind blows the quad around. No possible amount of amateur complaint letters (500 would be staggering) would cause us to change a TV rotor built for another purpose and manufactured 1000 units at a time. Write the letters—the accumulative effect may eventually help, but meanwhile inquire on every contact if any helpful hint may be known about this particular problem. You will be amazed at reactions from other amateurs. Usually a large sigh of relief, and your contact then explains he has been having similar problems but didn't want to admit it. Then it starts, and by the end of the QSO much useful info has passed both ways. You will find a wealth of expert technical information available 24 hours a day, with a fraternal desire to honestly help, that few manufacturers even understand and could not buy for any amount of money. Also the technical fake stands out like a sore thumb. This is the "expert" who has read all the ads, can expound by the hour why *his* particular equipment (purchased at a discount from a "secret friend" at the plant) excels any possible other product's operation. His only real technical information ends at the bottom of a full page ad.

On the other hand I personally know of several amateurs who have never soldered a single wire to another, but know more about what a CDR AR22 rotor cannot do, what it will, proper mechanical installations, correction of normally encountered faults, have a service bulletin and knows what it says, have noted down in their file that a letter to Bill Ashby K2TKN CDE—50 Ave. "L"—Newark, N. J. will eventually get an answer, and that any part needed for repair of any CDE rotor is in stock at their rotor plant CDE—118 E. Jones St., Fequay Springs, N. C.—"Att John Sumner" and a letter by air-mail to him gets you that part C.O.D. in a day or so—and—if you get desperate, pack any CDE TV rotor and control box securely, ship prepaid to John, his crew will completely rebuild, inspect, and check out the rotor and return same within a few days if you enclose a check for $7.50, which pays for all labor and parts, etc. HAM rotor rebuild—$17.50.

All the above is well known by many amateurs that you have been talking to all this time in all parts of the world. When you state that your "Brand X" "Whangen banger No. 3" is not working—the other guys will not

consider that you are waging a personal feud with "Brand X" company—they will usually be able to help with some info, possibly that this seems to be usual, and that you had better start trading up to a product designed for your application—which may help to make you a wiser if poorer amateur. Try calling "CQ—AR22 rotor information only" on 20 SSB and your receiver will lift off the table from "klank—klank—klank" as the VOX's kick off on the AR-22 systems turning your way to help, declaim, and commiserate with you. You may be pleasantly surprised how easily this apparently serious problem may be cured. All you have to do is get on the air and start making noise. Enough of this sort of thing and there will be fewer complaints about stereo-typed QSO's and considerably wiser purchasing by many amateurs. My comments above are about rotors, but hold just as true with any commercial products and the opinions are shared by most manufacturers. . . . K2TKN

Solderless Connectors Double As Control Knobs



Electrical solderless connectors, of the insulated type, are a readily available source of attractive, functional control knobs. These insulated fittings are available in two general types and a wide range of sizes which make them ideal for use with those odd size control shafts.

The photograph shows exploded views of the two common types, one with a coil spring insert and the other with a threaded brass bushing which is fitted with a set screw for completing the connection. The coil spring insert will thread tightly on threaded shafts such as are used on slug tuned coils. The set screw type is available in a number of sizes and is ideal for use with smooth shafts of odd dimensions. The photograph also shows one of these fittings installed on a slug tuned coil. The versatility of these connectors makes it worthwhile to stock a range of sizes to meet those unusual knob requirements.

. . . W4WKM

Photo: Morgan S. Gassman, Jr.

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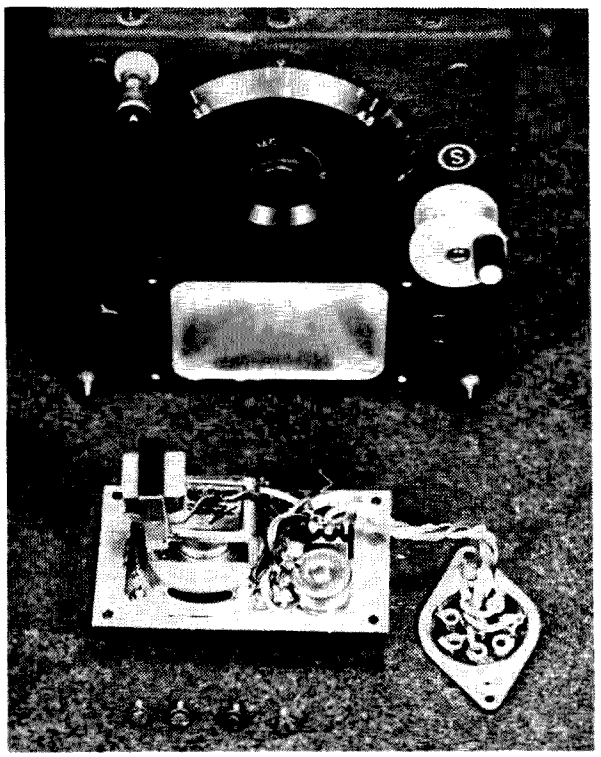
Command Set Speakers

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photography by: Morgan S. Gassman, Jr.

THE SCR-274-N and AN/ARC-5 Command Set receivers have enjoyed great popularity since their initial availability after the war. Large quantities of these receivers are still on the market and are priced very reasonably. While numerous amateur conversions have been developed for these receivers, provision of a self-contained loudspeaker has been a problem. Considering the components available when these receivers were designed, they are marvels of compact construction and there is very little free room for added parts.

Modern speakers and transformers have been drastically scaled down in size to meet the requirements of the transistor radio manufacturers and their production has proven ideal for Japanese industry. As a consequence, a wide variety of "Made in Japan" miniature audio components are available at very reasonable prices. Lafayette Radio stocks many of these items and their line, for ease of identification, is cited in this article. Other firms stock similar products although their advertising does not indicate as wide a selection.



Seeing is believing. The blank control panel from the front of the receiver mounts the speaker, line matching transformer, phone jack, RF gain control and BFO switch.

Lafayette speakers which are suitable for installation in Command Set receivers are listed below. All of these units are very reasonably priced, selling for $1.49 each. The square speakers are better suited for this application since they all have the conventional flange with 4 mounting holes while the round speakers require additional mounting hardware:

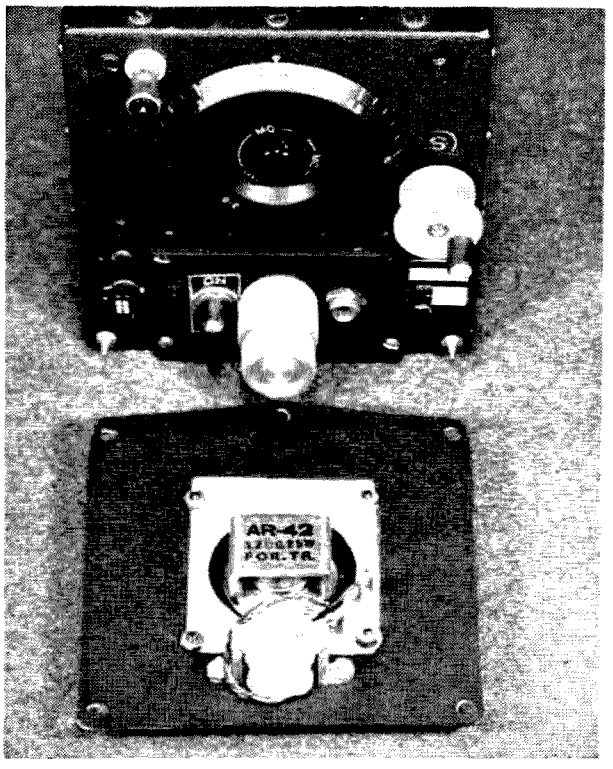
Type	Size	Style	V.C. Impedance
SK-61	1½"	Square	10 Ohms
SK-189	2"	Round	8 Ohms
SK-190	2¼"	Round	8 Ohms
SK-191	2½"	Round	8 Ohms
SK-65	2½"	Square	3.2 Ohms
SK-66	2½"	Square	10 Ohms

The first requirement for satisfactory speaker operation from the Command Set receivers is to obtain a reasonable impedance match between the output tube plate and the speaker load. The output impedance of the Command Set varies with type and model. Early SCR-274-N receivers were supplied with a single 4,000 ohm output winding while later production equipment incorporated an additional 300 ohm tap. The AN/ARC-5 and the postwar aircraft Radio Corporation Type 12 receivers were supplied with a single 300 ohm output winding.

Two courses of action are open. The original output transformer may be replaced with a plate to voice coil unit or a line to voice coil transformer may be connected to the audio output of the receiver. The latter method is probably best since it retains an output impedance suitable for headphone operation.

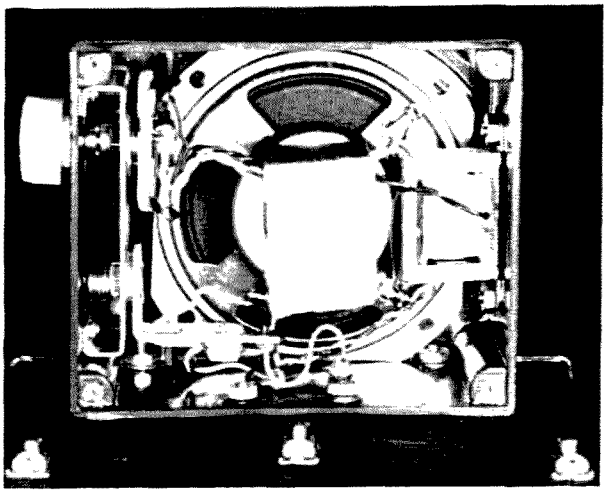
Miniature transformers, at reasonable prices, are among the imported items and these may be used as line matching transformers. The following chart lists the output impedances of the Command Set receivers, the more common voice coil impedances and suitable matching transformers. Once again, Lafayette part numbers are given. It should be remembered that transformer impedances listed are nominal values and that the turns ratio is of primary concern. While an exact match is not always possible, a reasonable match is obtained in each case.

Receiver Output Impedance	Voice Coil Impedance	Type	Design Impedance
300 Ohms	3.2 Ohms	AR-121	300 to 3.2 Ohms
300 Ohms	8 Ohms	TR-109	400 to 10-11 Ohms
300 Ohms	10 Ohms	AR-139	250 to 8 Ohms
4,000 Ohms	3.2 Ohms	AR-135	4,000 to 3.2 Ohms
4,000 Ohms	8 Ohms	AR-134	4,000 to 8 Ohms
4,000 Ohms	10 Ohms	AR-134	4,000 to 8 Ohms

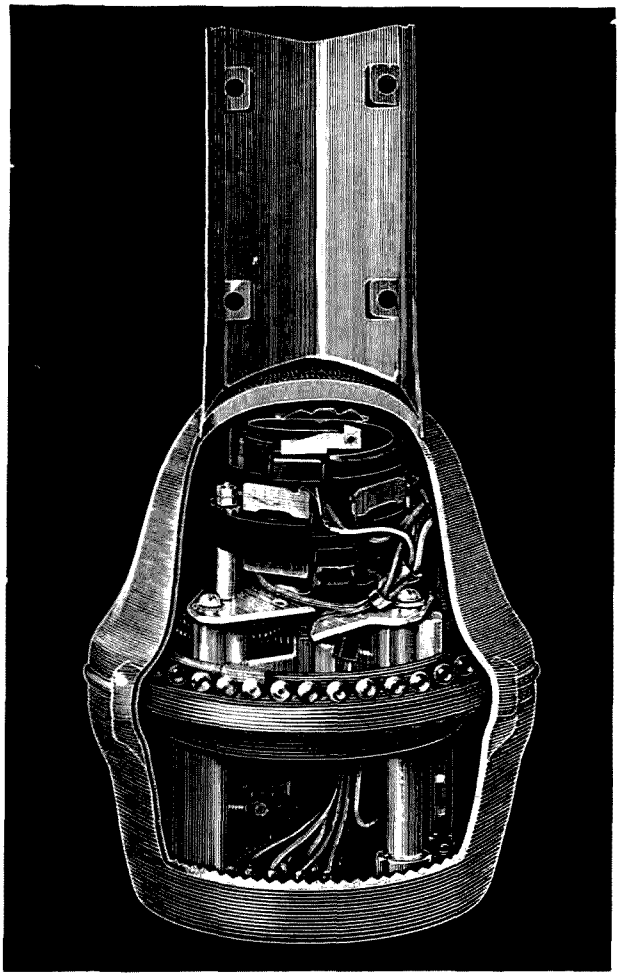


A 2½" PM speaker and miniature line matching transformer fits on the tube access cover plate of the Command Set receiver. Speaker grill is the insert from a dime store, plastic flower pot.

A remote loudspeaker unit, designed for use with TV sets, provides a good solution to the Command Set speaker problem. The unit shown in the photographs is a Lafayette Model SK-145. The compact plastic case measures 4" x 2⅞" x 1¾", excluding mounting feet and controls. The unit contains two 20 ohm speaker level controls and a 2½" square, 8 ohm voice coil, PM speaker. Also included is a 25', three conductor cable which is not used in this application. Audio quality is surprisingly good and



The compact, Lafayette Radio remote TV speaker is modified to include audio gain control, phone jack and line matching transformer.



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the unit is certainly worth the $3.88 asked.

In the receiver shown, the usual power supply modification is the only change made. The standard FT-260-A local control panel, or home brew equivalent, is installed and the SK-145 unit mounted to the top of the receiver. Remove the mounting feet; mark and drill the top of the receiver, using the mounting feet holes as a template. Drill an additional ¼" hole to clear the audio lead. Ground connection is made to a lug mounted under one of the hold-down screws. Determine the impedance of the Command Set audio output and select a suitable transformer from the chart. Mount the transformer on the side of the case as shown in the photograph. Remove the bottom audio level control and install a standard, normal through phone jack in the hole. Wire the unit as shown in Figure 1, extending the lead to the proper tap on the Command Set output transformer. BFO switching and rf gain control functions are provided by the FT-260-A control panel and audio level control is provided by the original SK-145 speaker level control. This arrangement is very simple and permits a "minimum" modification of the receiver.

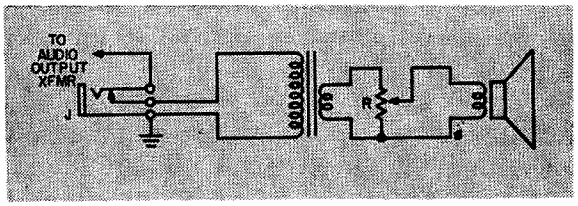
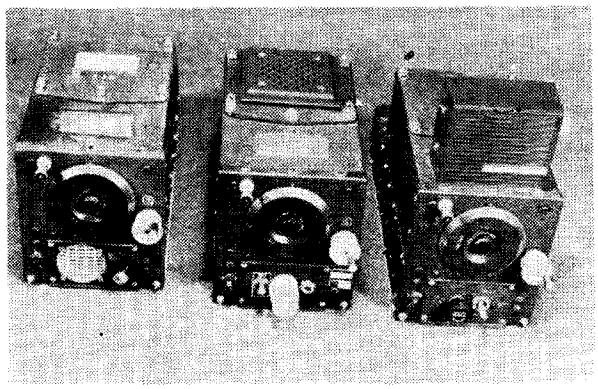


Fig 1. Revised wiring of the Lafayette SK-145 speaker for use with Command Set receivers.

The FT-230 (MX-21/ARC-5 in the AN/ARC-5 receivers) plug-in filler panel on the front of the Command Set receivers is an ideal location to mount one of the miniature speakers. In the SCR-274-N receivers, the audio output is available at the front connector. In the AN/ARC-5 receivers it is necessary to run a lead from Pin 2 of the rear connector to Pin 4 of the front connector. By careful parts selection and layout the 1½" square speaker, line matching transformer, BFO switch, phone jack and rf gain control may be installed on the



Three good answers to the Command Set speaker problem are presented in this group of these popular surplus receivers.

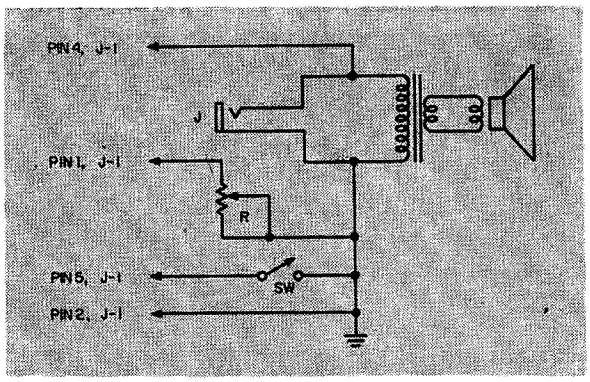


Fig. 2. Wiring for installation of 1½" speaker in Command Set receiver local control filler panel.

pane. Note that the cover of the FT-230 panel is removed along with the posts which support the connector. 2" leads are left between the panel mounted components and the connector to permit reassembly.

The line matching transformer should be selected from the chart and soldered to the speaker frame. The miniature S.P.S.T. toggle switch and rf gain control make this compact layout possible. The switch, another imported item, is available from ALCO Electronic Products Inc. of Lawrence, Mass., while the potentiometer is available from Lafayette and other sources. No drawing of the panel is supplied; lay out the parts with zero clearance and "hole move" until it all fits. It is not impossible, the photographs prove this! Wire the unit as shown in Figure 2 and you are in business.

Probably the best scheme of all has been saved until last. A 2½" square speaker may be mounted on the clip-on top cover of the receiver. The SK-65 (AR-42) speaker fits nicely if the threaded knob is removed from the center *if* transformer and the speaker mounted using ⅜" spacer posts. A suitable protective grill is installed over the speaker. The assembly shown in the photographs used the plastic insert from a dime store flower pot. A suitable line matching transformer is installed in the area above the 12SR7 tube and the leads terminated on a terminal strip secured by one of the speaker mounting screws.

The receiver shown in the photographs was extensively modified and the front plate mounts a concentric shaft, combination ac switch, rf and af gain control, normal through phone jack and BFO control switch. The ON-OFF switch plate is an aluminum foil, pressure sensitive item which is available from ALCO at 12 for 25¢.

The speaker mounting methods described in this article are truly practical. The completely self-contained feature is convenient and serves to reduce the hay-wire in the shack. While Hi-Fi is not one of the characteristics of these installations, the techniques used enhance the value of the Command Set receivers.

. . . . W4WKM

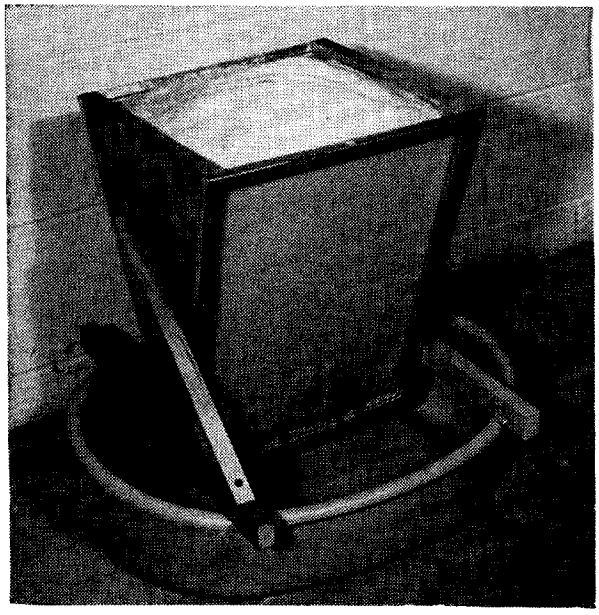
Chase That Dampness

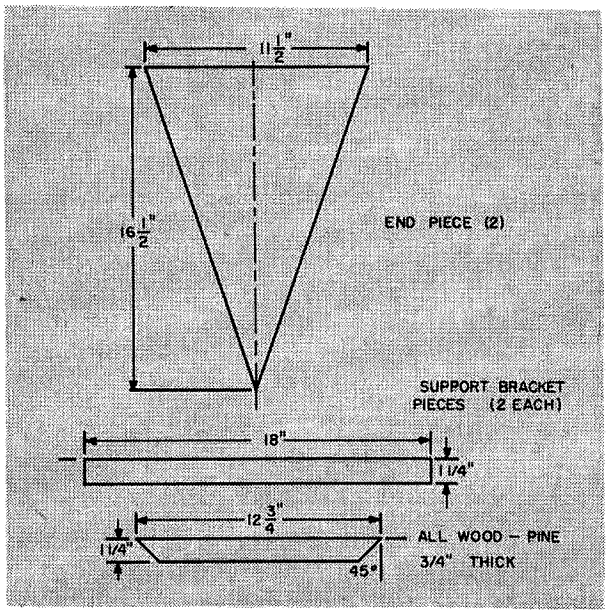
Photo by Jack Bohland Richard Genaille K4ZGM

DAMPNESS is a problem that most hams and experimenters have had to face or will face at some time or another during the course of their careers. As anyone who has ever had to replace costly electronic components can tell you, the price of keeping a shop or ham shack dry is well worth it in the long run considering the effects of high humidity on almost anything that can be found in a shop. Not only electronic gear is damaged but valuable publications, tools and countless other items as well.

When discussing the problem with others having moisture troubles the talk invariably gets around to wishing that one could afford a dehumidifier or better yet, a completely air conditioned home. In most cases, the use of mechanical dehumidifiers is out of financial reach. Many who give up in despair do not realize that for a few dollars one can rig up a fairly decent chemical dehumidifier and keep it going for a considerable period of time without additional expense. This article proposes to describe a simple system, in use in the author's basement shop, which can be tailored to suit ones needs and which has helped the author to keep his basement humidity to a reasonable percentage. The system is not nearly as perfect as a mechanical system might be but it can help to keep things under control until you can make the plunge to a more expensive means.

The unit shown in the photograph was constructed in very little time from scrap lumber and some "do-it-yourself" aluminum from the hardware store. As can be seen, two small aluminum screens were fabricated from the "do-it-yourself" aluminum hardware and screen wire and screwed to the two end pieces of wood. The support brackets keep the "V" shaped trough supported above a 20 quart wash basin. The size of the unit can be adjusted by the builder in order to accommodate larger or smaller drain basins. The chemical used in the unit is calcium chloride ($CaCl_2$) which has a great affinity for water. Calcium chloride can absorb its weight in water in a short time. The author paid approximately $4.50 for a one hundred pound sack which lasted for about three months. The time that this chemical will last depends upon how many units one has installed and, of course, how humid the basement becomes during rainy or humid weather. As the calcium chloride absorbs moisture it dissolves and drips into the basin. The salt solution in the basin should be emptied from time to time, preferably in a gutter. As can be imagined, the heavily concentrated calcium chloride solution can wreak havoc on lawn, plants and shrubbery. The author has used the solution along a fence to kill weeds and tall grass and on a dirt drive to keep the dust down. The high concentration of the solution keeps it from drying up for some time thus preventing dust from rising. Emptying the residue down the basement drain should be avoided due to possible chemical reaction with the house plumbing. The chemical dehumidifier should be kept filled with the calcium chloride for best results.





Don't wait for humidity to cause you trouble in your "ham" shack or shop. A small investment in time and money to build a chemical dehumidifier similar to the one described to chase that dampness may be one of the wisest investments that you have ever made.

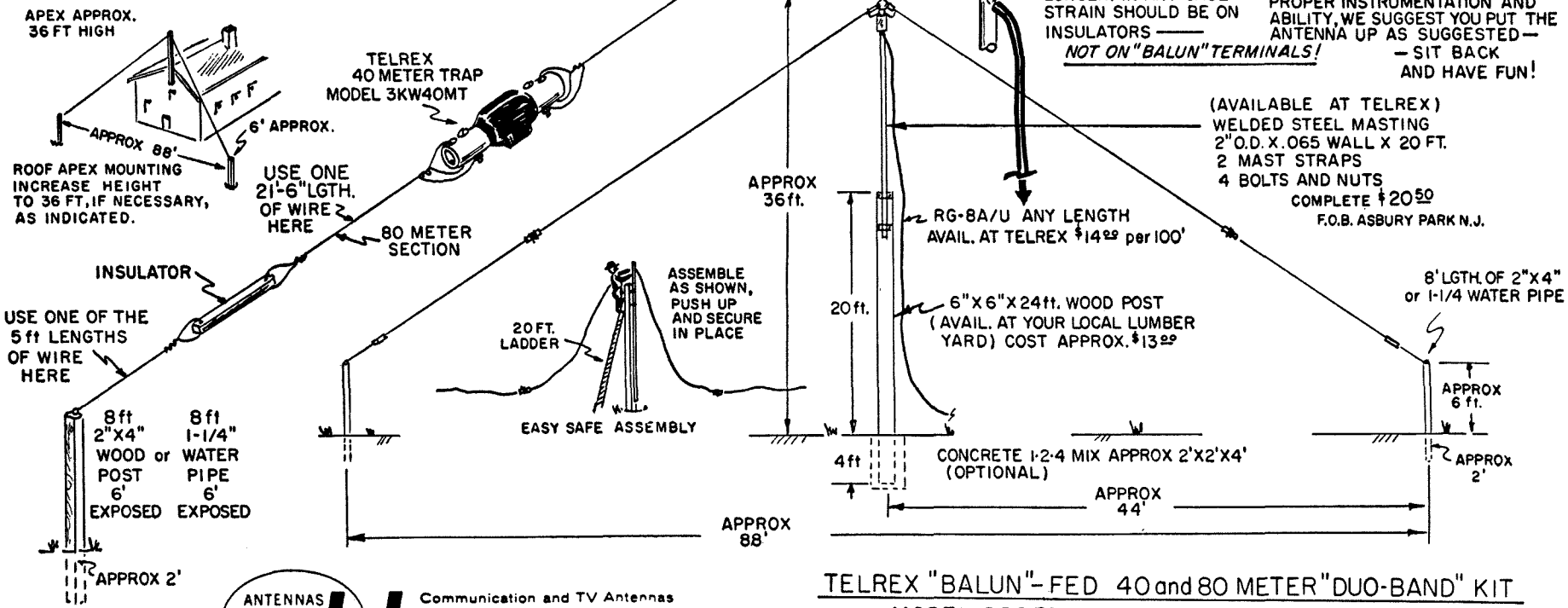
. . . W4ZGM

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3. 4 HIGH VOLTAGE INSULATORS
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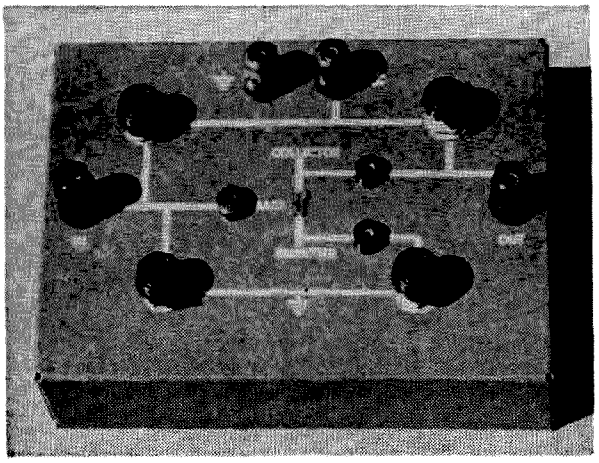
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If you are like the majority of we electronic mortals you're aware that the science of electronics is rapidly leaving you far behind, with probably, your area of most rapid fossilization in the field of solid state devices. There are three possible approaches to this dilemma; (1) close up shop and go to school, (2) ignore the entire thing and hope it will go away, and, (3) do something about it at home. Approach number one has its merits, but most of us have become accustomed to eating and would like to continue the habit, also a lot of us have become attached to the XYL—albeit in a somewhat detached manner. Approach number two is easy but its success seems a little in doubt at the moment. Approach number three brings us to the subject of this article.

It frequently has been the lot of Joe Blow ham, service man etc. to, of necessity, determine the operating parameters for a familiar transistor in a new application, or perhaps even more often a new or different transistor in a known circuit. It has also been the lot of a few of us to fall heir to a transistor for which we have no available literature. To all of these categories the unit illustrated will probably furnish an answer.

An examination of the circuit diagram of Fig. 1 will show it to be transistor "hook up" in the usual grounded emitter configuration. The feature that makes this unit valuable is the presence of variable resistances in each transistor lead. This feature allows a wide range of base currents, collector load values, etc., to be adapted to any given type of transistor. All these parameters can be calculated I know—but can you do it? Especially if you have no data sheet for the transistor you are holding in your hand.

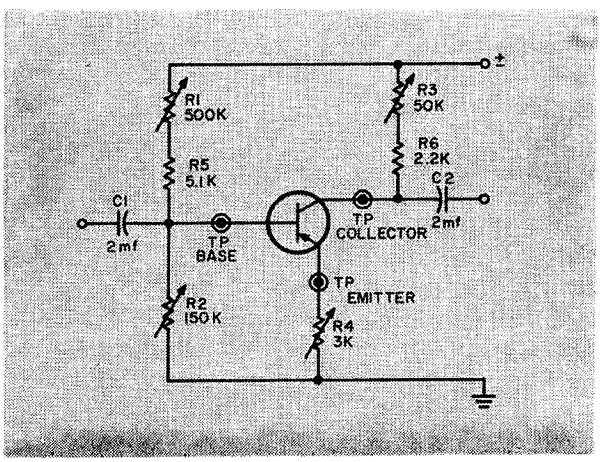
Lets take a typical case. You have a solid state device in your possession which has 2N000 printed on the side and you can find no information on it what-so-ever. You want to use it in a preamplifier circuit for your tape recorder let's say. First, you don't even know if it's a NPN or a PNP. Well, to find out, you should remember one thing—the base of a three terminal transistor is biased in the forward direction, in other words the base-emitter direction will have low resistance to current flow when a voltage is applied with the correct polarity. Don't put an ohmmeter on the device to measure this resistance, such action can easily ruin a good transistor. The easiest way to do this is as shown in Fig. 2. This is a 1½ volt flashlight battery, a resistor and a meter with a one milliampere or greater sensitivity, your bench multimeter with its 100 microampere scale is fine. With the transistor base and emitter placed across the test terminals the reverse bias polarity will show very little or no current flow through the circuit while the correct, or forward, polarity will show a current flow of approximately the same value as if the test terminals were shorted. Let's say that with the base going to the plus side of the battery the maximum current is indicated on the meter. This means that the base is a "P" or the transistor is a NPN, collector N, Base P, emitter N. If the base is to the negative end of the battery for maximum current flow the base is a "N" or the transistor a PNP. The small arrow shown on the transistor emitter lead in a solid state circuit diagrams always points towards the negative potential. If the transistor is a PNP which operates with the negative potential on the base the arrow will point towards the base, while if it is a NPN with the positive potential

on the base it will point away from the base.

Now since the base is biased in a forward direction and the collector in the reverse direction our NPN transistor must have the positive side of the battery to the collector or "hot" terminal of the test unit, with the negative going to the grounded side. Our next question is a sticker—how much voltage do we put on the transistor? There is no real good answer for this if you have no information at all on your 2N000, however let's start with a 7½ volt C battery and see how we do.

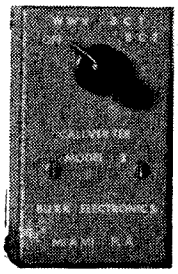
Turn all potentiometers in a full clockwise direction, plug in the transistor, connect the battery with the minus going to the ground, connect your af generator to the input and your oscilloscope to the output. I might say right here that you should have an oscilloscope of some kind to do any work with transistors. Those little solid state devices can turn a perfectly good sine wave into the nicest square wave you ever saw. Beg, borrow, steal or even buy a scope if you want to work with transistors.

Now that we are all connected, apply about 10 millivolts from the af generator into the tester and look at your scope. You probably will see a very badly distorted wave shape if anything at all. Start turning R1 counterclockwise until the tester output cleans up into a good sine wave. You will find that some



1—Wire all potentiometers for full resistance in circuit when in counterclockwise position viewed from top.
2—Use non-polarized condensers for C1 and C2 as the supply voltage will change from plus to minus depending on transistor type.
3—TP—Test Points.

combination of R1 and R2 will give a nice undistorted output. If it doesn't, look for a bad transistor socket connection or a new transistor. Assuming the transistor is good and you have a good output you will notice that the gain goes up as R4 is turned counterclockwise out of the circuit. This is normal and represents a parallel situation to an unbypassed cathode resistance in a vacuum tube



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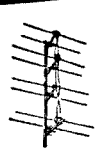
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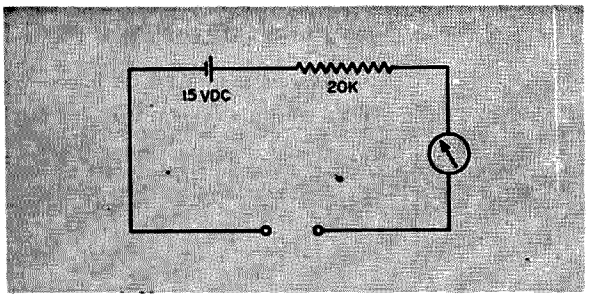
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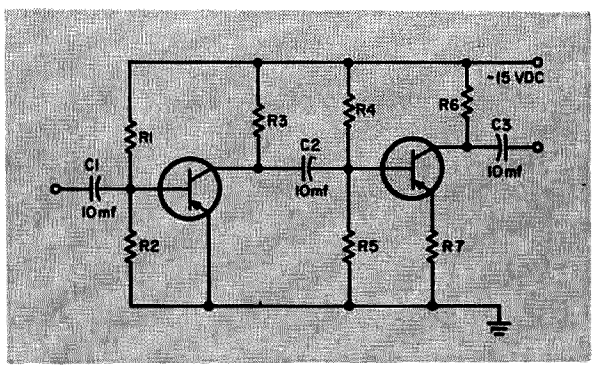
circuit. By the proper adjustment of R1 and R2 this R4 resistance can be turned completely out of the circuit. By now, with R3 clockwise, R4 counterclockwise and R1 and R2 adjusted properly you probably have a gain of at least 100—ten millivolts in, and one volt out.

Now since transistors are really current, and not voltage amplifiers you should load this stage with the impedance you are going to use. If it's going into a tube circuit with a high value of grid resistance this is not so important, however if its load is to be of a relatively low value, place a resistor of this value across the tester output and then adjust R3 for maximum output—readjusting R1 and R2 if necessary to prevent distortion. You will notice that as your external load resistor goes down in value you must also go down in value with your collector (R3) load resistor to maintain the stage gain. This is analogous to a vacuum tube where a low mu tube such as a 12AU7 with its low plate load resistor is used when power is desired in the output and a 12AX7 with its high plate load resistor is used when only a voltage gain is desired. Care must be taken as you reduce the collector load resistor that you don't exceed the maximum collector current for the particular transistor used, however with the test circuit as shown in Fig. 2, this situation is not at all likely to happen.

By now you have arrived at some definite conclusions, no doubt. First; the base bias, it should be called current instead of voltage, is relatively critical for a given set of conditions, but the exact value of R1 and R2 is not at all critical, as long as the correct ratio is observed. As a general statement, if your stage is operating in a high temperature environment, or the transistor has a high collector current it is well to keep R2 resistance relatively low, say around 5K or so, and adjust R1 as required. However, if the operating conditions are OK then R2 can be of any value up to an open circuit with R1 again adjusted for correct base current. Two; R4 acts like the cathode resistor of a tube circuit, i.e., it is degenerative when not bypassed, thereby allowing higher inputs without overloading the stage, but in so doing it reduces the gain. Three; R3 can be of high value when the stage has a high impedance load but must be reduced as the stage load impedance is reduced.

Now let's go through a two stage amplifier for your tape recorder head output for an example of how this tester can help you. The circuit is shown in Fig. 3. Let's say your head puts out 2 millivolts and you want an output of one volt from your amplifier. This represents a voltage gain of 500. Let's aim for a gain of 20 in the first stage and 30 in the last which will give us the 500 with a little to spare.

Connect your transistor, known or unknown, into the test unit as previously described and adjust R1 and R2 for proper base current (bias). Now since this stage feeds another transistor stage the load resistance is rather low, the value of 2,000 ohms being about correct for a grounded emitter circuit. Connect a 2K resistor across the tester output and measure the output. It probably will be below the 40 millivolts required for the gain of 20, (notice we are not using any R4 in this stage so turn this potentiometer full counterclockwise). Now reduce the value of R3 until the 40 millivolts are obtained, readjusting R1 for no distortion if required. Remove the battery and transistor and measure the resistances in the transistor lead circuits. It is always best to remove the battery first as you can damage a transistor by the current surge if you remove or replace it with the battery connected. R1 plus R5 and R2 are measured from the test point (TP) in the base lead to the "hot" battery terminal and to the ground respectively. Measure from the test point in the collector lead to the "hot" terminal for R5 and mark the values found on the diagram for R1, R2 and R3.



Now replace the transistor and battery and apply 40 millivolts to the input and again adjust for correct base current as shown by an undistorted output. As this will be the output stage of your preamplifier and you will be feeding the high impedance input of your main amplifier which uses tubes, the input impedance probably will be around 500K. Use this 500K ohm resistance value for the tester load, and after R1 and R2 are adjusted for proper base current, measure your output. You will probably have an excess of one volt. If so, turn R4 clockwise, putting resistance into the circuit, until the output drops to the desired one volt. Now remove the battery and transistor, measure the resistance values and

you are all set to build the amplifier. Your input and interstage coupling condensers should be large as indicated because of the low input impedances of the transistors, otherwise you will lose gain, especially at the low frequencies.

You now have a transistor amplifier "designed" without even knowing, at the start, if your transistors were NPN or PNP.

This amplifier is a simple circuit to design and I have described a simple "tester." You can make a tester as complicated as you wish by adding meters to the various element legs, provisions for external loads of various kinds, such as transformers, etc. Even provisions for applying feedback circuits if desired. I think, however, that this tester as is, will get us started on the right track and especially it will allow us to use our old transistors which we may have on hand and for which we have no data.

It's simple and cheap to build—go to it.

. . . W6EUM

Tapping Polystyrene

Here is an easy way to tap polystrene, lucite, or plexiglass so often used to support coils and rf carrying components. Drill a hole slightly smaller than the screw to be used, fasten the screw on a "self holding" screwdriver and heat over a flame. The screw will then neatly cut the threads. Be careful, though, not to get it too hot. . . . W7INX

Tube Sockets to Crystal Sockets

Tube sockets make very usable crystal sockets in an emergency. An octal socket will hold 2 FT-243 crystals. For the smaller HC/6U crystals, (.050 dia., .486 spacing) a 9 pin min. socket will hold 2 crystals.

To adapt the smaller pin (.05) HC/6U to the larger (.093) pins, slip the pins from an old octal tube over the pins on the crystal. The pins can be soldered to make it permanent but do not use excess heat.

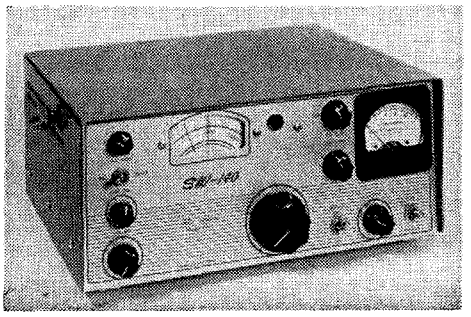
. . . WA2INM

Pilot Lamps for Compact Equipment

Miniature pilot lamps that take up little room and draw a very small amount of current can be made from NE-2T pigtail neon lamps. They can be used with 115 volts ac by placing a 200,000 ohm resistor in series. The lamps can be panel mounted in rubber grommets that have ¼" inside diameter. . . . W7INX

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SW-175 3.5-4MC. SW-140 7.2-3 MC
SW-120 14.2-14.35 MC

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130 watts PEP input to 6DQ5 Power Amplifier.
High frequency crystal lattice filter; 3 Kc. nominal bandwidth, used for both transmit and receive.
Unwanted sideband down approximately 40 db. Carrier suppression approximately 50 db.
Transmits automatically on receiving frequency.
Exceptional mechanical, electrical and thermal stability. Frequency is practically unaffected by voltage or temperature variations, or by vibration when driving over rough roads.
Receiver sensitivity better than 1 microvolt at 50 ohm input.
Smooth audio response from 300 to 3,000 cycles provides excellent voice quality for both transmitting and receiving.
Control system designed for greatest ease of mobile operation. Front panel controls include: Main Tuning, Volume, Carrier Balance, Microphone Gain, Exciter Tune, P. A. Tune, P. A. Load, T-R Switch, Supply On-Off Switch, and Tune Switch.
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Transceiver produces approximately 25 watts carrier output on AM by simply adjusting the Carrier Balance control. Receives AM signals very satisfactorily.
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SOME time ago the author described a simple break-in system which was easy and cheap to construct, relatively simple to install, and had *no* relays.[1]

However, after considerable on-the-air operation, one or two shortcomings of the system became apparent, and it was decided that these would have to be corrected.

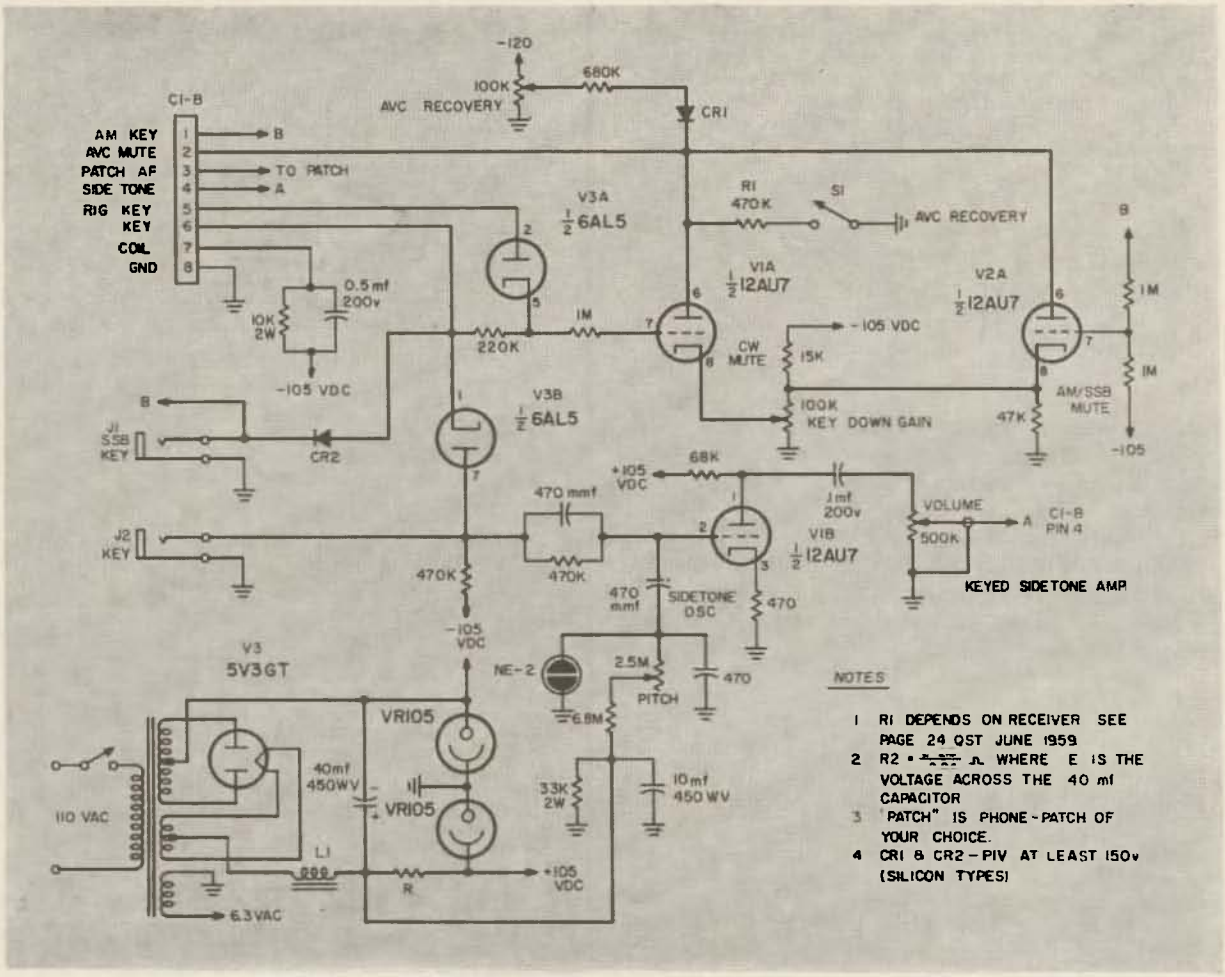
The principal source of trouble was the electronic TR switch. Lack of reliability (too-often replacement of the tube), coupled with poor weak signal performance on the higher bands, indicated that the TR switch would have to go, even if a relay would have to be substituted.

The second bothersome point was that the sidetone oscillator was slightly "clicky" when keyed, and did not have a particularly "list-enable" tone. Modification of this circuit, then, was also indicated.

In the earlier unit the key down gain was variable for all modes of emission, so that on AM or SSB the control had to be turned to minimum gain. The addition of a switch allowed this to be taken care of more easily, but still left something to be desired. Thus a third modification provides full muting on AM and SSB, but left the key down gain variable on CW. In addition the sidetone had to be turned off manually on AM and SSB. This was made automatic in the new unit.

As with the earlier version, the revised system was applied to a Heathkit Apache transmitter and a Hallicrafters SX-100 receiver. The adaption of the system for use with other combinations of equipment will be discussed later.

To replace the TR switch a small light relay was chosen and used as a TR relay. The schematic of the associated circuitry is



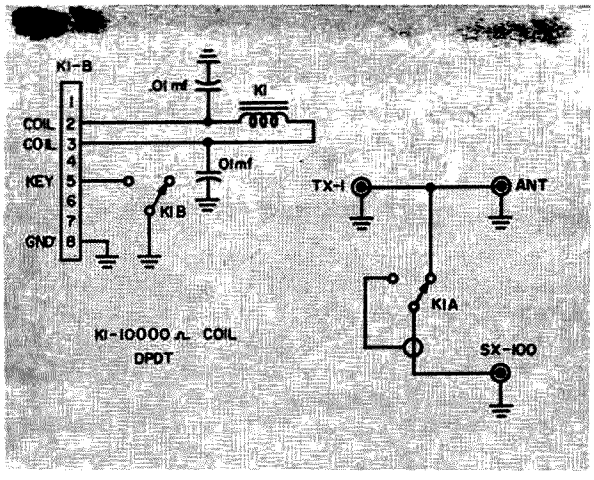


Fig. 2

shown in Fig. 2. In the system here all of this circuitry is mounted in a small minibox which is fastened to the back of the transmitter with self-tapping screws. The box is located near the output connector on the rear apron of the rig. Where this box is placed is not critical, but it should provide a shielded enclosure around the relay for best results. In this vein, if it has not already been done, it would be well to replace the input connector to the receiver with a coax fitting.

Figs. 2 and 3 are the schematic and interunit cabling diagrams respectively. On CW the circuit is keyed at key jack J2. The NE-2 Sidetone Oscillator runs continuously and the key removes the blocking bias from the keyed sidetone amplifier, allowing the output to be fed to the receiver. Diode V3B allows the key action to be fed to the rest of the circuit on CW, but prevents keying of the monitor on AM and SSB.

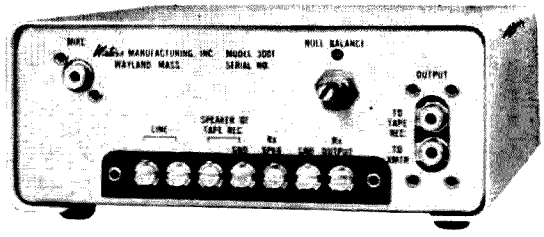
Closing the key also grounds the plate of the diode V3B, bringing its cathode up to approximately ground potential. This removes the —105 volts of bias from that point, allowing V1A to conduct, muting the receiver to an extent determined by the cathode voltage, which is set by the key down gain control. In addition the coil circuit to the relay is closed, operating the relay. In addition to removing the receiver input from the antenna and grounding it, the second contact grounds pin 5 of connector K1-B (Fig. 2). This is the line marked "Rig Key," and grounds the key line in the transmitter and removes protective blocking bias from the final and modulators. Diode V3A insures that the receiver stays muted until the relay opens.

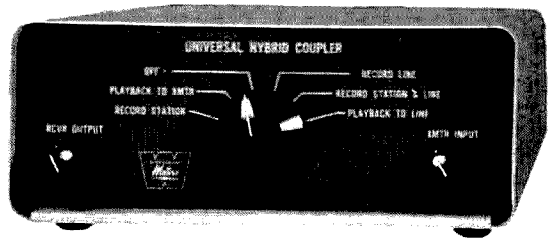
CR3 prevents receiver muting when the transmitter power is off, and CR4 prevents the spotting circuitry in the transmitter from keying the blocking bias on the final and modulators.

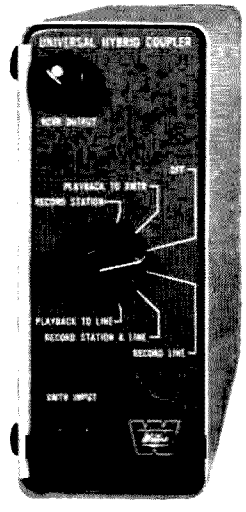
On AM either the internal or the remote plate switch is used as a transmit-receive

[1]—Horwitz, "Simplified Break-in Control," p. 24, QST, June, 1959.

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switch. When the switch is on the internal relay in the Apache is activated, and grounds the line at TX-1-B. This is the AM key line, and when grounded it keys the relay and the CW muting circuit through CR2. However, it also keys the AM/SSB muting circuit V2A which overrides V1A and provides full muting. The final and modulators are normally biased to cutoff to protect them, and these are keyed on through Pin 5 of TX-1-A, which is the original accessory socket on the rear apron of the transmitter.

On SSB the lead from the VOX relay in the SSB exciter is plugged into J2. When this is keyed to ground the antenna relay and the muting circuits behave as on AM.

CR1 is used to partially clamp the AVC line to a bias slightly greater than that expected for a very large signal. In effect CR1 helps the receiver recover very fast for strong signals, and speeds up the recovery considerably for weak ones. Switch S1 provides fast recovery for all signals, but reduces AVC

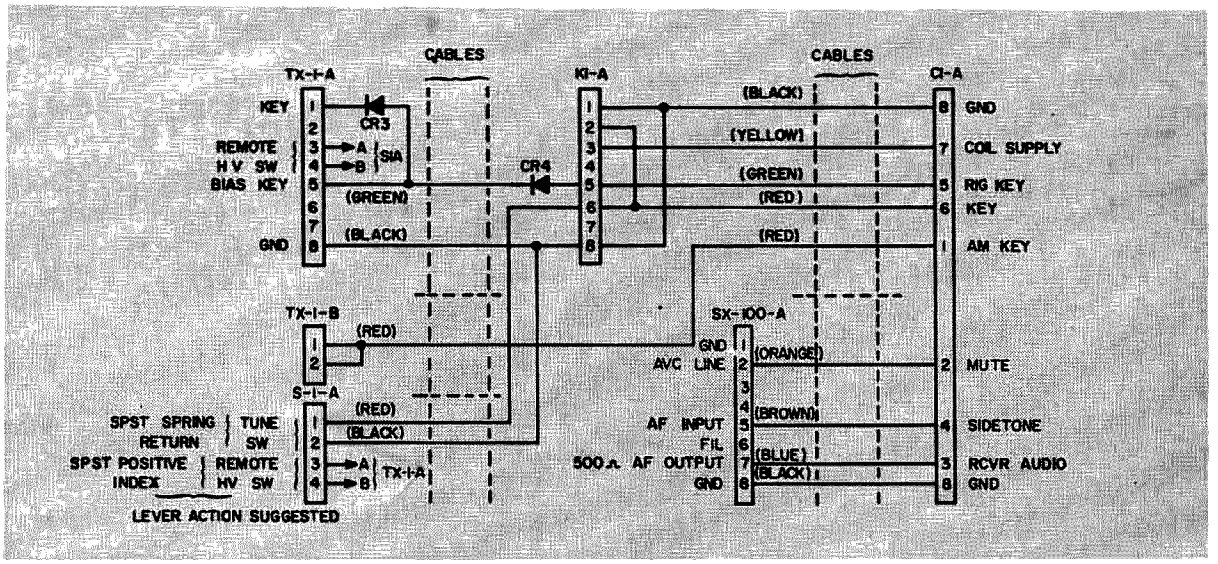


Fig. 3

action when it is closed.

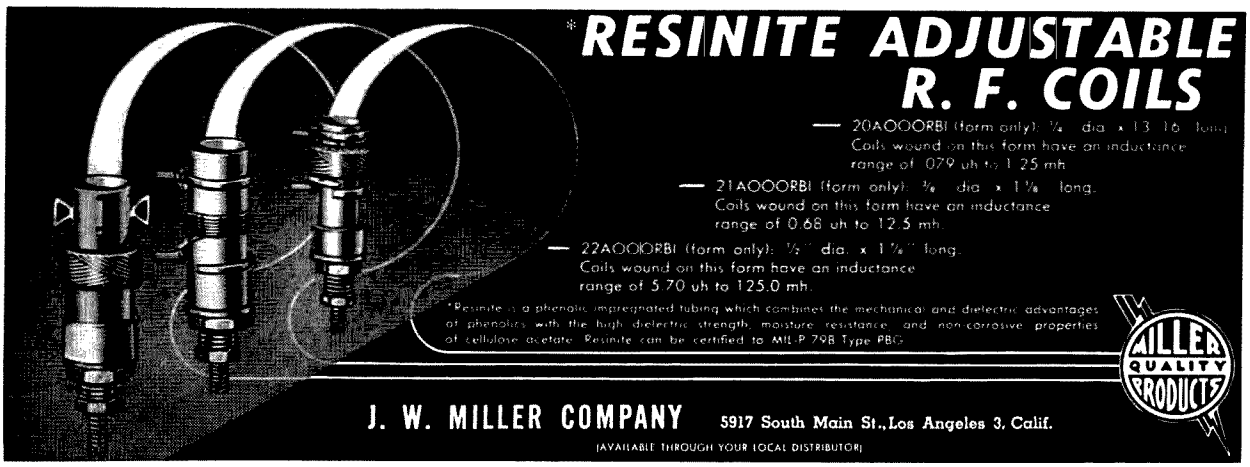
All of the silicon diodes could be replaced by 6AL5's or equivalent. However CR3 and CR4 are wired right into the plugs at which they are shown in Figure 3, so if this convenience is desired then silicons will have to be used at this point.

Figure 4 shows the internal modifications to the control circuitry in the Apache. The first modification, which is not directly concerned with break-in, but which is shown in Figure 4A for the sake of completeness, concerns the addition of a relay to enhance spotting operation. With a TR switch or relay the amount of signal supplied by the Apache VFO is extremely strong at the receiver input, so that it is sometimes difficult to hear the station being zero-beat through the VFO. Whether or not this is necessary will depend on the particular transmitter used, as will whether or not contact K_{1a} is needed.

Relay K_2 in Figure 4 is the original 110 vac relay in the Apache. Note that the contacts and coil connections have been rewired. The relay does not operate at all on SSB or CW, but only on AM. The contacts at TX-1-B are used to key the break-in circuitry on AM. Be sure to notice that the lead from the plate switch has been *disconnected* from the key line, so that the TR relay actually keys the rf. This is part of a rather complex interlocking arrangement that protects the receiver from receiving a dose of 150 watts of RF and prevents the modulators from operating without load or the finals without drive. If for any reason the break-in unit should fail to operate, the TR relay would not key the transmitter, keeping the modulator and final biased off through the bias key line. (This protection does not, of course, protect against failure of some component in the transmitter itself, such as the driver tube.)

Figure 4B shows the modifications to the rest of the control circuits. The keying half of the plate switch is disconnected, as mentioned above. Pin 5 of the accessory socket is now active on AM and SSB, when it is used to key the final and modulator. On CW the spotting relay keeps the final (the modulator is off because K2 does not operate, removing screen voltage) on except when the spotting switch is pressed. This allows spotting to be accomplished on CW without turning off high voltage. Note that Pin 1 (remote key on AM) is now connected to the internal key line on all modes. Keying is *not* done through the transmitter key jack, which would defeat the protective features of the system by applying full power to the receiver input. The system is keyed through J2 on Figure 1.

It might be well to point out that jack SX-100-A is the original accessory socket on the SX-100 receiver with certain pins removed from their former circuitry and reconnected. The steps to take here should be fairly obvious for those who are using SX-100's, and similar terminals should be made available on other



receivers.

The 500 ohm AF output is for the phone patch which is built into the same box here at W4HBO, and has nothing to do with break-in. However, in the interest of station neatness this lead may just as well be bundled with the others into one neat cable. The lead af input is connected through a 220K to the grid of the last of stage in the receiver.

This unit may be relatively easily adapted to other transmitters. If the rig is not keyed by the grid-blocked method, then the addition of a keyer tube will be necessary. Suitable circuits for keyer tubes have appeared in the Radio Amateur's Handbook, as well as other publications, and will not be discussed here.

The modifications to the mode switch will, of course, depend on the particular rig, and the circuitry involved. However, the principle involved is as follows: On CW pressing the spotting switch should apply full bias to cut-off the final and driver, and if necessary, remove screen or screen and plate voltages from the driver. On AM spotting will normally be done with high voltage off. In my unit the spotting switch is inactive with high voltage on, on AM. The modulators and final must be biased to cutoff on AM if the high voltage is turned on but the keying circuits fail to operate.

This unit has been developed over about a one year period, and at this writing has been in operation in its final form for several months. Although the writer does not claim perfection by any means, this system does provide smooth and reliable break-in operation, as well as tying together station control functions on AM, SSB, and CW. It certainly was well worth the time and effort involved in building it.

. . . W4HBO/2

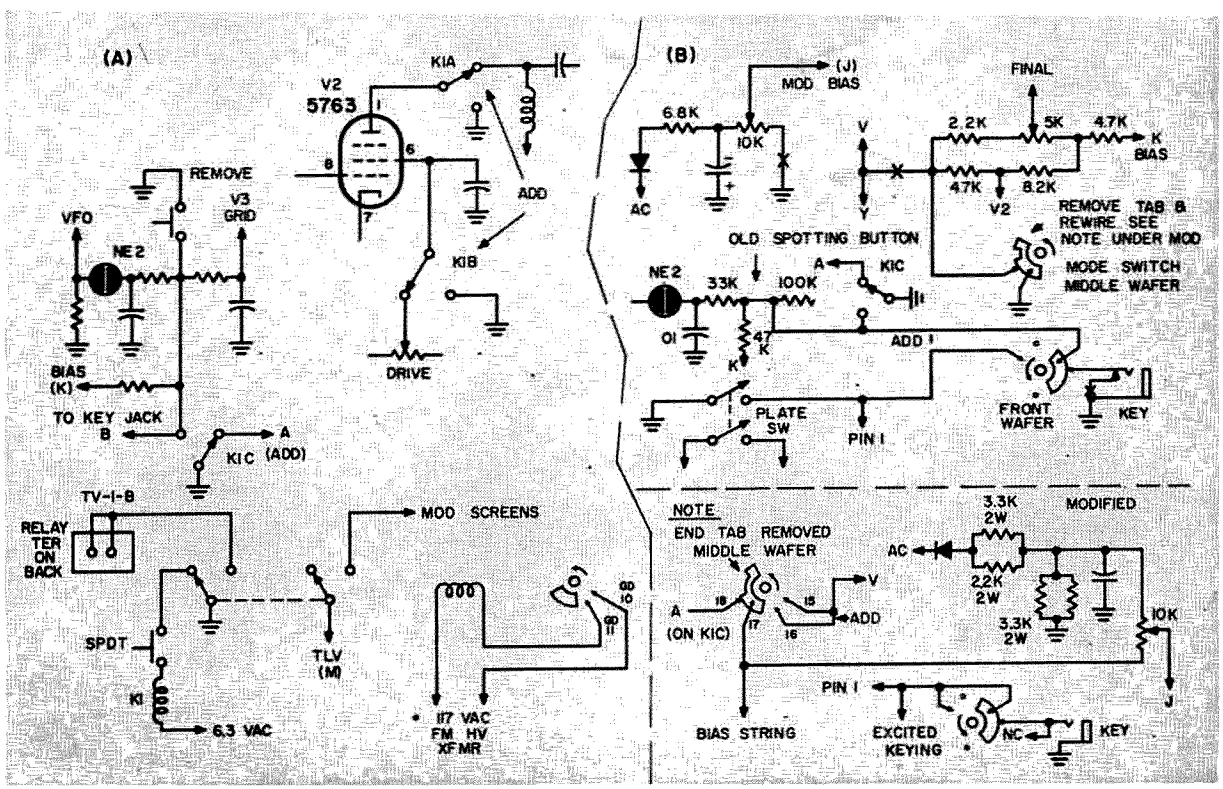


Fig. 4

Amateur Moonbounce on 1296 mc

Some practical aspects

Don Goshay W6MMU

QUITE a few years have passed since the amateurs first closed the two way earth-moon-earth path. The early efforts were centered around 144 mc, since at that time, this was the only amateur band for which satisfactory equipment existed. Even with one kilowatt transmitters, large antennas, and the best receivers, a return signal from the moon was, and still is, marginal.

Now, as well as then, it was known that much better results could be obtained by going higher in frequency. The 1215—1300 mc band seemed like a good bet for a long time, but sufficient power was not available, either from unstable or crystal controlled sources. At the other end of the circuit, commercial and particularly amateur receivers, had not reached a degree of perfection sufficient to generate much interest in 1215—1300 mc work. Further, most amateurs had not yet become on speaking terms with the king of microwave antennas, the parabolic reflector.

In 1961 the situation has vastly improved in all phases but one. Before discussing hardware, however, let us turn our attention to the two way path loss equation of Figure 7 for a moment. If the equation is arranged properly, it yields significant facts to the amateur interested in Moonbounce work.

Stripping the above equation of its mathematical cloak, it shows that the received signal is:

1. Directly proportional to the fourth power of the dish diameter,
2. Inversely proportional to the square of the wavelength,
3. Directly proportional to the transmitted power.
4. Inversely proportional to the fourth power of the distance between the earth and the moon.

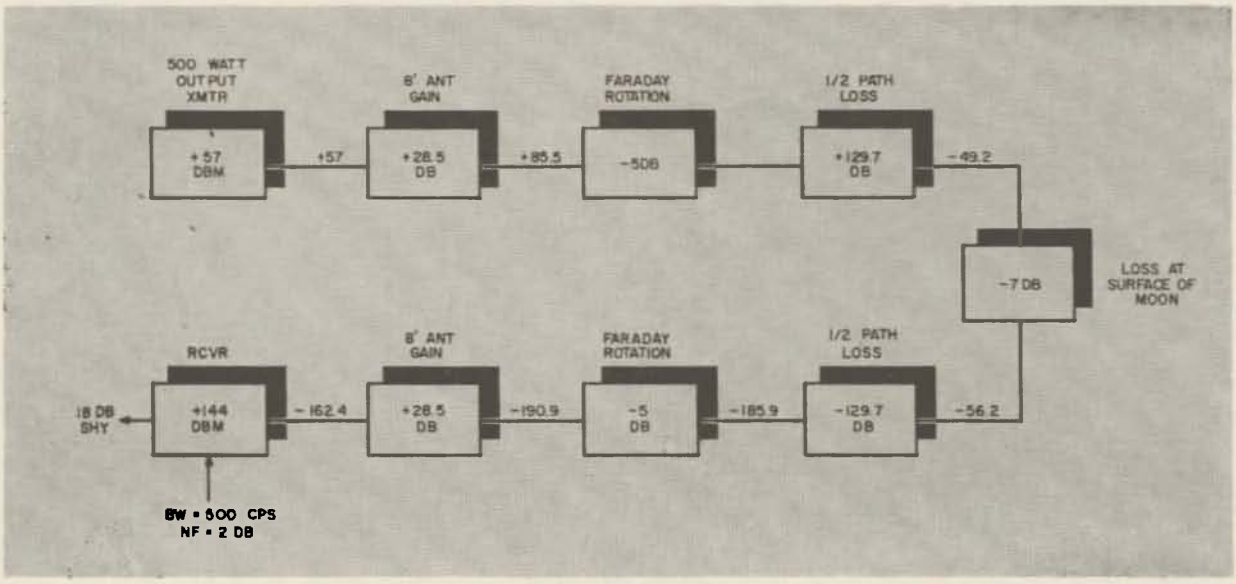
Figure 1 is a block diagram of a complete

Figure 7

The ratio of the power received to the power transmitted, assuming the moon to be a perfect reflector, and no Faraday polarization rotation, is:

$$\frac{P_R}{P_T} = \frac{\pi^2 D^2 d^4}{1024\,\lambda^2 R^4}$$

Where π = 3.14; D = Diameter of the moon; d = Diameter of the parabolic reflector; λ = wavelength; and R = distance to the moon, all in compatible units (the equation may be easier to work with when inverted). Aperture efficiency of the dish is assumed to be 50%.



circuit. Note that with 500 watts output, an 8 foot dish, a 2db receiver noise figure, and a 500 cps bandwidth, the return signal is typically 18 db below the background noise. Considerable additional improvement is needed for armchair copy!

As the path loss equation shows the received signal to be proportional to the fourth power of the parabolic reflector diameter, this area is the most vulnerable to improvement. An 18 foot dish has 7 db more gain than an 8 foot one, both going and coming. This would reduce the deficiency discussed earlier to only 4 db. However, an improvement such as this does not come about without the expenditure of considerable care and effort. Holding the necessary mechanical tolerance becomes more difficult on larger dishes. The overall tolerance should be no more than ± 9/16 inch deviation from a true parabolic curve over the entire surface. The larger dishes are necessarily heavy, and require a well thought out rotating system. The aiming requirement for large dishes is further complicated by the fact that the beam becomes narrower as the dish diameter is increased. Figure 2 gives the significant characteristics of a number of dish sizes. The 1 db beamwidth is significant, as this becomes 2 db for a two way path. If a signal is "nip and tuck" with the noise under optimum conditions, it will be 2 db below the noise when the antenna is oriented at the 1 db point. Therefore, a smaller dish is better than a large one that is aimed inaccurately.

Also given in Figure 2 is the time for the moon to travel from the center of the beam to the 1 db point. This gives one an idea of how alert the operator must be if manual tracking is used. For any dish 8 feet or larger, a telescope attached to the rotator is essential.

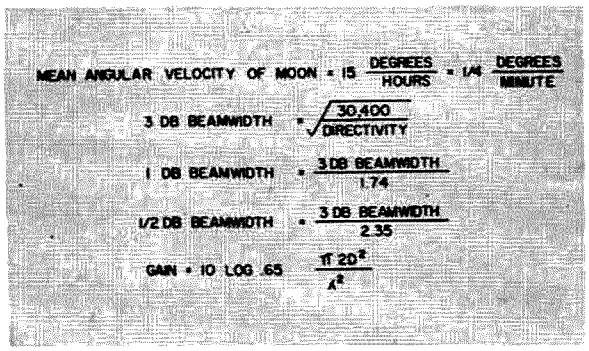


Figure 2

Diameter	Gain, DB	Beamwidth, Degrees 3 DB	1 DB	Time, Minutes Center To 1 DB	Directivity
2 Feet	16.4	27.0	15.0	30	44
4 Feet	22.5	13.0	7.5	15	178
6 Feet	26.0	8.7	5.0	10	400
8 Feet	28.5	6.5	3.8	7.6	710
10 Feet	30.4	5.3	3.0	6.0	1,100
12 Feet	32.0	4.3	2.5	5.0	1,580
14 Feet	33.4	3.7	2.1	4.1	2,180
16 Feet	34.5	3.3	1.9	3.8	2,810
18 Feet	35.5	2.9	1.7	3.4	3,550
84 Feet	48.9	.63	.36	.7	77,500

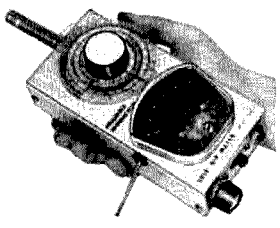
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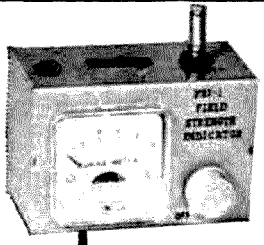
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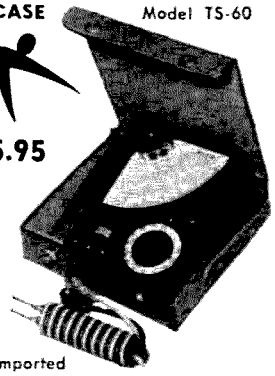
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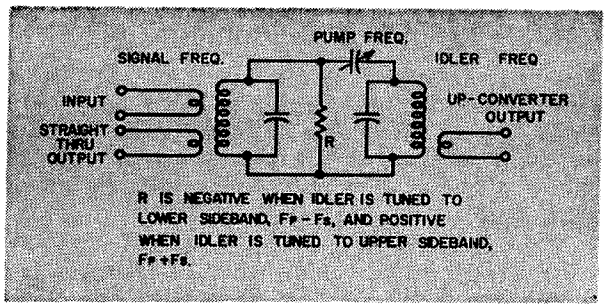


Fig. 4

Amateurs wishing to construct their own reflector would do well to consider focal lengths somewhat greater than usually found on dishes available through surplus channels, as tolerances are a little easier to hold and slightly more gain may be had with increased focal length. Plane parabolas similar to the one appearing in a recent QST article seem of limited value, as the driven element for this type of unit is exceedingly complex. The focal length of a parabola may be determined quite closely from the following relationship:

$$f = \frac{(\text{diameter})^2}{16\ (\text{depth})}$$

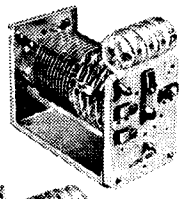
The numbers given in Figure 2 indicate that the biggest job may well be in the construction or acquisition of a suitable rotating system, especially if the antenna is large. The Two Meter and Down Club was fortunate in locating an SCR-584 Radar Pedestal on the surplus market. This pedestal has extreme rigidity, is well built, and weighs 2400 pounds. The six foot dish made a nice cradle for carrying the eight foot reflector, now in use. A larger dish will be substituted if and when one becomes available. The system is presently being aimed with a war surplus 8 power telescope with illuminated cross hairs. Four miniature solar cells have been purchased for incorporation in the eyepiece at the proper point. With the solar cells, we hope to drive a dc amplifier which in turn will energize two Teletype relays. The Teletype relays will actuate four heavy duty relays, which in turn will cause the proper motor to turn in the proper direction to keep the antenna beam on the moon.

Since the received signal is inversely proportional to the square of the wavelength, best results are obtained by going to as high a frequency (as short a wavelength) as we can. This upward trend in frequency is limited by the amount of stable power we as amateurs can generate at increasing frequencies, and by our ability to build sensitive and stable receivers. The compromise presently seems to be 1296 mc.

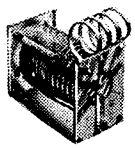
A great challenge for amateur enthusiasts is offered in the field of receivers, particularly in parametric amplifiers and detector circuitry. While the principles of parametric amplifiers have been covered sufficiently well for now,

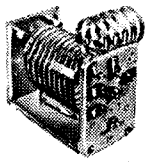
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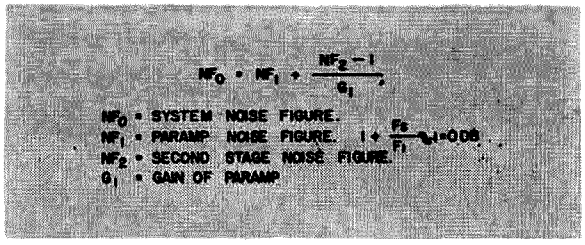


Fig. 5

good workable hardware is non-existent as far as can be determined. Several of the available designs have been tried. All have been made to work, but none work without considerable tinkering. None are relibale. This is a field that requires the teamwork of the electronic wizard and the mechanical genius with access to some machine shop facilities. Technique, rather than theory, needs to be developed.

Figure 3 is a summary of characteristics of the different types of parametric amplifiers often mentioned in the literature.

Figure 4 shows the equivalent circuit of a paramp. The class within which a particular amplifier falls depends upon from which terminals the output is taken, which sideband is selected by the right hand tank, and the pump frequency.

Figure 5 gives the classical SYSTEM noise figure equation. The point to notice here is that, ideally at least, the paramp contributes no noise whatever, and that the overall noise figure depends upon the noise figure of what succeeds the paramp, divided by the gain of the paramp. For best results, therefore, the remainder of the system must have a very low noise figure; *OR*, the paramp gain must be quite high. It is for this reason that the USB up-converter (Figure 3) has limitations, as its gain is much less than the LSB or straight through systems, and low noise figure stages to back up the paramp are hard to achieve at the upper sideband frequency.

The LSB up-converter has received little attention by amateurs to date. Since at least one commercial manufacturer has utilized this system, it must possess some merit. With the

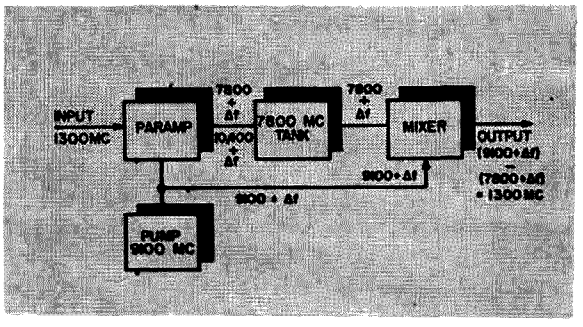


Fig. 6

straight through amplifier, the *frequency* stability of the received signal is preserved. This is not the case with either up-converter configurations. With up-converters, the stability of the amplified signal is that of the pump oscillator, which in most cases, is some sort of self excited oscillator. However, if the amplified signal is again mixed with a portion of the pump oscillator output, the *frequency* instability factor is cancelled, and a stable signal results at the same frequency as the input signal. Such a system is that of Figure 6.

Fig. 3

Type of Amplifier	Output Freq.	Idler Tank	Stability	Gain	Noise Figure	Note
Straight Thru Amp	f_s	f_p-f_s	Unstable	Theoretically No Limit	$1 + \frac{f_s}{f_i}$	1
USB Up-Converter	$f_p + f_s$	Not Required	Stable	$\frac{f_i}{f_s}$	$1 + \frac{f_s}{f_i}$	2-4
LSB Up-Converter	$f_p - f_s$	Not Required	Unstable	Theoretically No Limit	$1 + \frac{f_s}{f_i}$	1-4
Degenerate Amplifier	f_s	Not Required	Unstable	Theoretically No Limit	$2\left(1 + \frac{f_s}{f_i}\right)$	3
Down-Converter	$f_r - f_p$	f_s-f_p	Stable	$\frac{f_s}{f_i}$ (Loss)		3

1. These types are termed negative resistance or regenerative. Their gain is limited in practical cases, to that which can be obtained without oscillation.
2. USB = "Upper Sideband"; LSB = "Lower Sideband."
3. The last two types are of little interest to amateurs, and are included here for completeness.
4. While the idler tank is not required for these versions, the equivalent is generally used for the sole purpose of rejecting the unwanted sideband, or, passing the desired one.

f_p = Pump Frequency
f_i = Idler Frequency

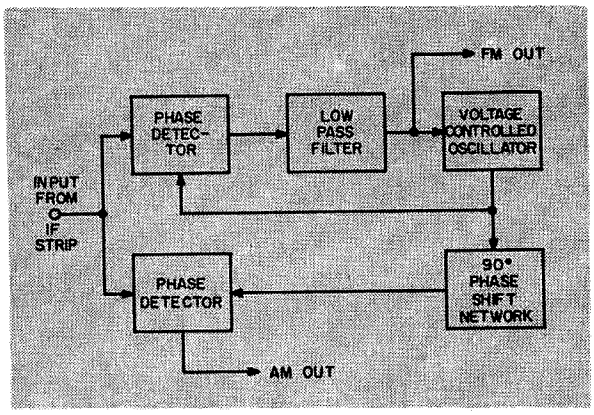


Fig. 8

The merits of the many types of detector circuits have been argued for years by the dc men, and most of those arguments apply to our problem. There is one type of detector, however, that is quite different. This is the so-called phase coherent detection system. There are several forms of this circuit, but probably the most useful will be the one shown in block form in Figure 8. Briefly, this circuit allows one to reduce his effective bandwidth almost as much as he pleases, provided slower and slower ICW keying rates can be tolerated. A 5 cps effective noise bandwidth can be achieved without undue difficulty using this system. This reduction would give 20 db improvement in receiver sensitivity, without changing the *if* strip. If the phase detector system is handled properly, there is little increase in frequency stability requirements as would be associated with the same bandwidth accomplished by the more orthodox methods. This system is especially suited for slow FSK when receiving signals from another station via the moon.

So far, each point we have touched upon has been one which the most eager of amateurs can bring under control. Perhaps the real obstacle is in transmitter power which in a general sense lies beyond our control, in that suitable devices cannot be built in one's backyard. Amplifying Klystrons seem to be the real answer, but none seem to be available for 1296 mc. The celebrated Eimac-Microwave Associates "Amateur" Moonbounce circuit employed Klystrons originally intended for another frequency range. At one kilowatt input, the output is discouraging. The 1 KW FCC power limit is obviously no drawback as long as no means of exceeding it exists.

Vacuum tube systems appear to be impractical at this frequency if any great amount of power is involved. Discussions have frequently revolved around the prospect of reducing frequency from 1296 to 1215 mc to take advantage of improved vacuum tube efficiency. However, the increased path loss resulting from the wavelength squared factor of the path loss equation at least equals (or exceeds) any advantage gained from that approach.

In conclusion, it might be said that the day of the ingenious, patient experimenter has finally returned in amateur radio. You cannot (yet) buy most of the things needed out of a catalog or at the corner HI FI store. The 1961 amateur now has the opportunity and challenge that faced his counter part of the twenties and thirties to devise his own hardware and improve upon it, thereby advancing the state of the art. . . . W6MMU

Stabilizing Mobile Oscillators

Bud Copping
P. O. Box 111
Lakeshore, California

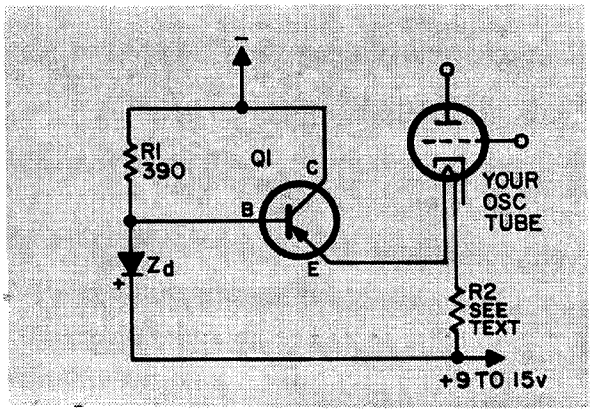
HERE is a circuit which I feel should be incorporated in all Mobile 12 volt transmitters, receivers, and transceivers, whether home-brewed or commercially conceived. It can be added to existing equipment fairly easily, using three or four small components. Most well-designed communications equipment supplies regulated voltage to the screen and plate of any self-excited oscillator, such as VFO, LO, and BFO. However, this is only half the story. The oscillator heater voltage should also be regulated, certainly in mobile gear. The "12 volt" supply can vary from 10 volts (idling at a stoplight at night with the lights on and the rig energized), to 15 volts during daytime highway travel. This variation can effect more than a 2 to 1 power dissipation change in an oscillator heater (considering it a fixed resistor). The resulting cathode temperature change will vary the tubes Gm and interelectrode spacing. This can drive an otherwise stable oscillator 'ape.'

In these days of single-sideband (the author's mode of operation for the past ten years), and VHF mobile work, etc., such a condition can take all the joy out of mobileering. There also is an important safety factor involved. No driver should have to fight drifting equipment and today's traffic at the same time.

Following is a simple circuit, which for about $4 to $6 will allow only 1/10 of a volt change at the oscillator heater, even if the supply should swing between 9 and 17 volts!

The following suggestions are offered—

1. Use a Zener Diode of 6.5 to 8.3 measured volts (with 10 or 20 mils flowing through



it). Target value is 6.5 to 6.6 volts, which would allow replacement of R2 with a wire. A lesser voltage will not allow 6.3 volts at the tube. A higher voltage will require use of R2 in the circuit.

2. A power transistor with a high Beta (above 50) will give excellent regulation, but most any unit should suffice.
3. In Negative-Grounded automobiles, bolt the transistor directly to a metal heat-sink such as a cool part of rig's chassis, with only a film of Silicone grease between (this grease not essential at these dissipations). With positive ground, transistor case must be electrically insulated with a mica or anodized-aluminum insulator available with the transistor. Also insulating shoulder washers must be used at the screws to prevent grounding the case. A lug is then used against the case to provide a connection to the collector. If no cool area is available, mount the transistor on an outboard heat-sink fabricated of ⅛" aluminum of at least 12 square inches area, exposed to ventilation. Lead length is not critical.
4. A 10 or 20 ohm pot. can be used as R2, and adjusted to give the desired heater voltage at the oscillator tube socket (6 volt tube plugged in). The pot. can then be measured and a fixed resistor substituted for it. A 2 watt rating should handle the higher current heaters.
5. It may be necessary to lower the value of R1 (but do not go below 82 ohms). This due to the use of a fairly high zener voltage, a very low Beta transistor, a high current tube load, or a combination of these factors. R1 must be low enough to supply adequate base current and some zener current, and high enough to keep zener within ratings.

Some features making this circuit a 'Natural'—

1. At these voltages, zeners exhibit excellent voltage/temperature stability and low dynamic impedance. This affords good regulation.
2. Most any power-type transistor should work, due to low voltage requirement and grounded collector configuration which eliminates IcO problems.
3. In negative grounded automobiles, case is bolted directly to chassis for negative collector connection and the best heat transfer.
4. A wide range of 5 and 6 volt tube types can be stabilized. Two or three 150 ma. heaters can be paralleled to include 2 or 3 separate oscillators with the same regulator. These could be receiver local oscillator, BFO, and transmitter VFO (all 6 volt).

Caution: Use a small hot iron when soldering semi-conductors, and apply heat very briefly. Observe all polarities carefully. Leave the pigtail leads full length if possible. Do not apply ac to this circuit.

This device will soon see service in a home-brew mobile 75 meter SSB transceiver, combined with CB circuits. With this circuit, you will enjoy a conversation piece; a hybrid rig. This infers that you have flavored your vacuum tubes with *semi-conductors!* A magic word these days. See you on '75.' ... **W6FIR**

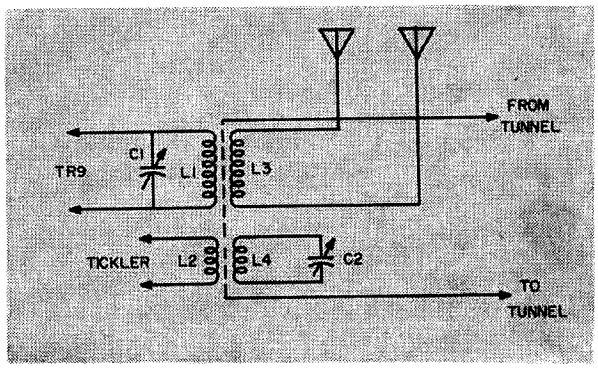
Parts

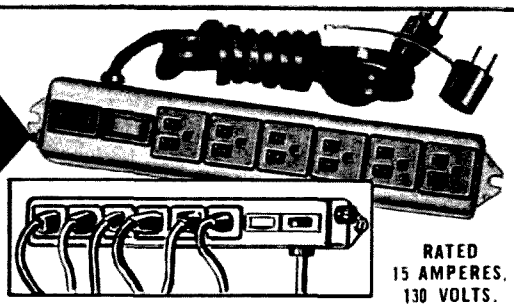
Q1—PNP Power type Transistor such as Motorola 2N1544, 2N1360, 2N669.
R1—390 ohm ½ Watt Resistor. Ohmite etc.
R2—Value selected to match obtained Zener Diode to desired tube type. See text.
Z1—1 Watt 6.5 to 9.0 Volt Silicon Zener Diode such as Motorola 1N3016B (6.8 volt 5% type) or 1N3017 7.5 volt 20% type).
V1—Your oscillator tube or tubes (see text)
Caution: Do not use a 12 volt heater tube here. Substitute a 6 volt type equivalent for your existing 12 volt tube.

AN IMPROVED TANK AND ANTENNA CIRCUIT FOR THE PORTABLE KW TRANSISTOR XMTR

Wretched Earhart K7NTE
1312 Heather Lane, S.E.
Salem, Oregon

AFTER constructing the Coward Portable KW Transistor Xmtr[1] considerable difficulty was experienced with the tank and antenna circuits. In the first place the tank circuit heated up so much, the copper conduced the heat back to TR9 and caused a failure in the unit. Secondly it was found that



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- "U" Ground Receptacles
- Adaptor Free

Model 24CB (Circuit Breaker Type) $10.50

the rig had a number of parasitics in the antenna circuit. As a result it was put on the shelf until Dr. Stein's article[2] on using the tunnel diode for isolating thermal conduction appeared.

The improved circuit is shown in Fig. 1 but due to space requirements just the final coil complex is shown. It will be noted that instead of the usual Faraday grounding connection Dr. Stein found it expedient to connect the low side of the screen to the tunnel input and the higher side to the tunnel output. This circular system permits the heat to be properly dissipated in the tunnel.

Despite the Faraday screen the tunnel circuit increased the parasitics in the antenna circuit. Possibly the cause was raising the screen above ground potential. In any event, it was found if the L4 Sartain coil and the 72 Mutch padding condenser were added in place of the simpler Hay wire coil the parasitics could be suppressed. The rig is no longer shelf bound and no reports below a 5 x 9 have been received as yet.

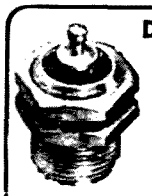
. . . . K7NTE

[1]"Portable KW Transistor XMTR" 73 Magazine, August, 1961; Vol. I. No. 11.

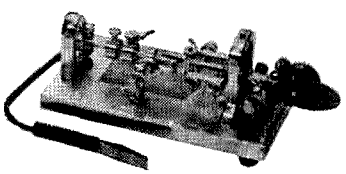
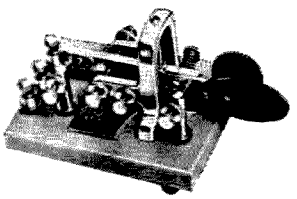
[2]"Kühl Das Berhälter" Frank N. Stein Zeitschrift Fur Narheit Apr. 1961; Vol. II, No. 1.

K7NTE

It should be pointed out that while many letters of accolade were received as a result of the K2PMM article, this is the first to bring carping criticism and we must assume that K7NTE is a troublemaker and probably didn't follow the original instructions. If interest remains at its present fever-pitch we may run a separate article on the newly developed K2PMM transistorized power supply which will completely replace the trailer-drawn unit of the original article. This new supply, while only applicable to twelve cylinder cars in its present stage of development, will enable you to run up to five kw on SSB without noticeable heating of the engine block. . . . . *editor.*


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POST OFFICE BOX 9222 SAN ANTONIO 4, TEXAS



Rig is attached to underside of dash with bolts and heavy guage aluminum angle.

Hank Schorle, Jr. W3GSC
3172 Colony Lane
Plymouth Meeting, Pennsylvania

The Hanky Box

WITH the continuing prospect every few years of securing a replacement for the family buggy, and the toil of re-jeeping the car radio for mobile operations facing me, a do or die decision was reached. I decided to do it right just once and then change cars with no hamming difficulties.

This aim was realized by building my mobile transmitting and receiving desires, plus broadcast reception for the XYL and conelrad into one neat package that would fit with ease into any average vehicle. The total size upon completion is 5¾"H x 11"W x 8"D, with a transistor power supply mounted on the rear of the cabinet. This space houses with no great crowding a conventional broadcast receiver circuit with a TNS noise limiter, a 10 meter converterette, a 45 watt VFO or crystal controlled 10 meter transmitter complete with plate modulator, and a meter with switching circuitry to read all pertinent data.

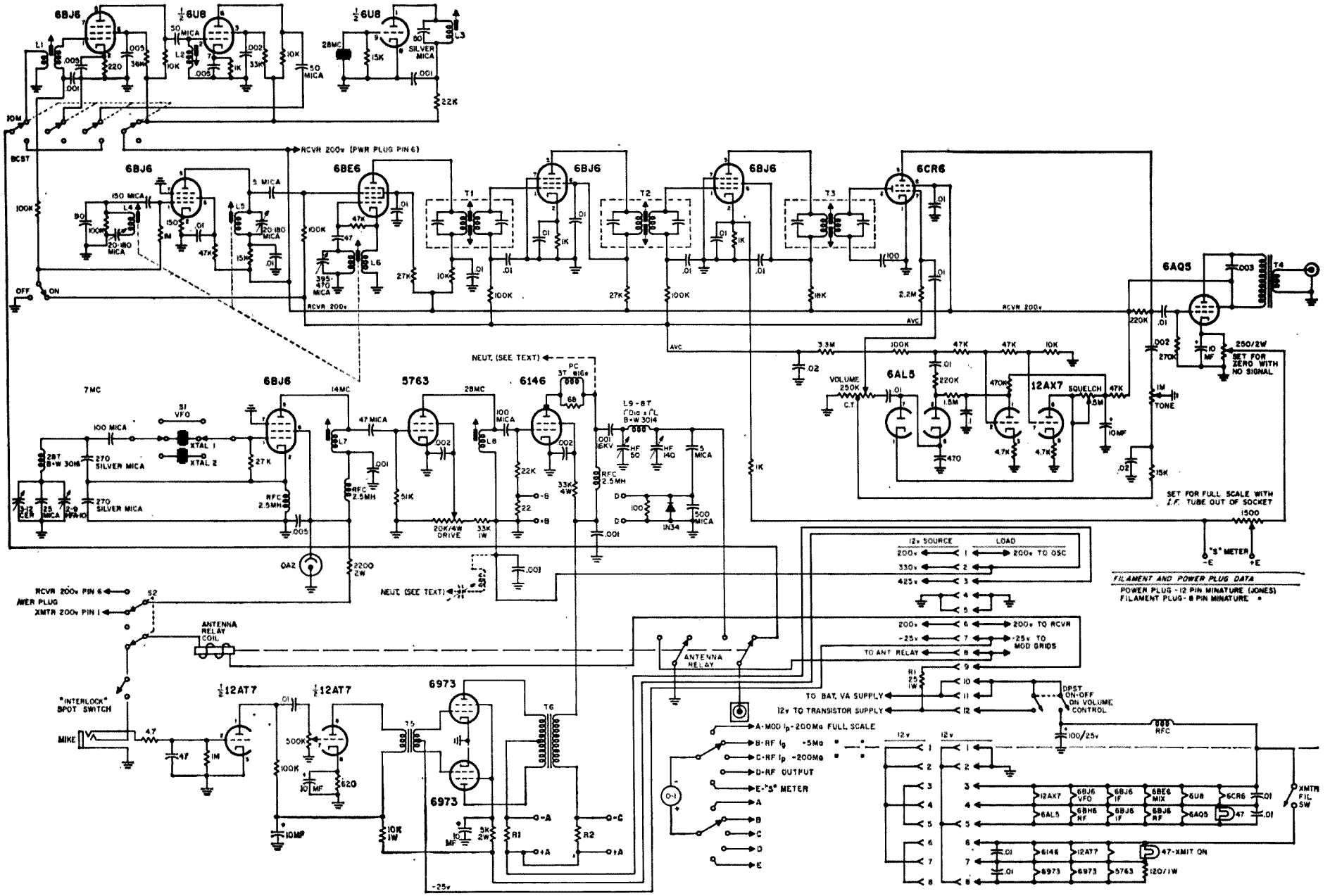
Ten meters was chosen to fit my desires due to local activity, but any band could be chosen, and I've already considered a two bander on 10 & 6. Most mobiliers operate on one band, and that is why I feel a "Hanky Box" type rig is a better buy than a multi-band commercial job.

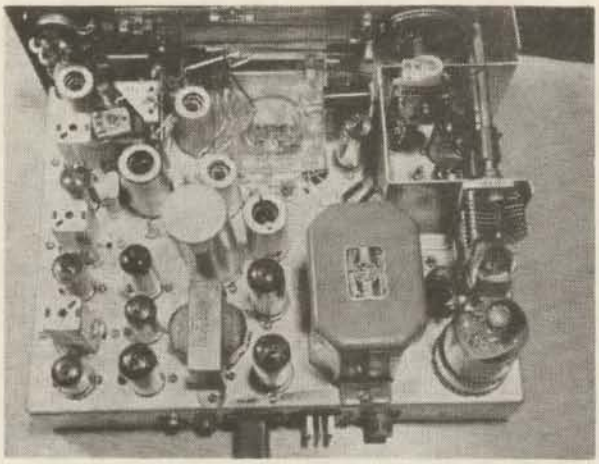
The cabinet is a California Chassis Co. Low Temperature Cabinet, Model LTC 470. It was procured directly from the manufacturer, as I don't believe they have any distributors east of the Rockies. The circuitry does not constitute anything revolutionary, but its layout must be considered fairly efficient to get it in one chassis 11" x 8" x 2" without layering components.

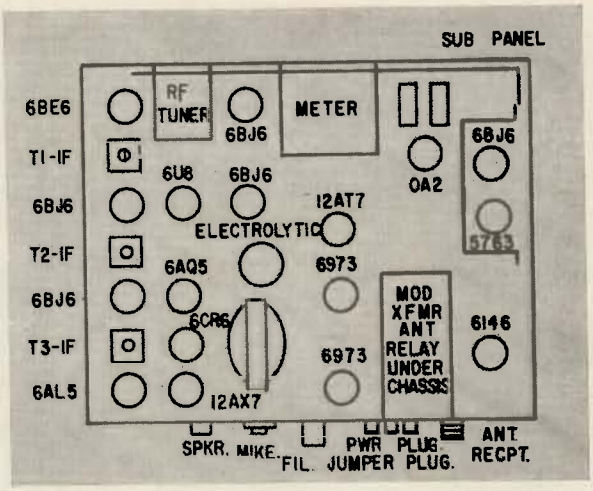
The heart of any receiver is its tuning mechanism, and part of the secret in space conservation comes from securing from an old auto radio a 3 ganged inductive tuner. My unit only occupies 1½" x 2" of chassis space, and with it's associated trimmer capacitors neatly tunes the broadcast range, and 28.55 to 29.7 mc when placed behind the 10 meter converter. It came out of a 1952 Chevy-Motorola radio, but there are several similar units available in auto radios, or as replacement parts from the distributors. Most run around $5.00 new. Usually a manually tuned unit is to be preferred over a push button type, as they are smaller, less complex, and therefore more trouble free.

Most broadcast circuits use only one *if* stage, but here a second was added primarily to provide better skirt selectivity with the 455 kc *if* and help separate stations when 10M opens up. This brought along with it more signal, and necessitated the 100K audio dropping resistor between the detector and TNS. This need is more apparent on the BC band than 10M, especially since the author lives between 3 local high power AM stations' towers.

The audio & TNS are quite standard, with a tone control and AVC applied to the first audio grid. For better copy of weak stations an AVC off-on switch is used, but it only kills AVC on the converter and rf stage of the BC circuit. Letting the rf end run un-biased gives a better S/N ratio which also helps hearing the weak ones. It was originally intended to kill all AVC, but the *if* strip had too much gain, and the resultant 10 meter hiss and hash


6BJ6
½6U8
½6U8
6BE6
6BJ6
6BJ6
6CR6
6AQ5
6AL5
12AX7
5763
6146
6973
6973
½12AT7
½12AT7
6BJ6
RCVR 200v (PWR PLUG PIN 6)
RCVR 200v
AVC
NEUT. (SEE TEXT)
XTAL 1
XTAL 2
VOLUME 250K
SQUELCH
TONE
"S" METER
ANTENNA RELAY
ANTENNA RELAY COIL
"INTERLOCK" SPOT SWITCH
MIKE
RCVR 200v PIN 6
XMTR 200v PIN 1
AMER PLUG
12v SOURCE
LOAD
200v TO OSC
200v TO RCVR
-25v TO MOD GRIDS
TO ANT RELAY
TO BAT, VA SUPPLY
12v TO TRANSISTOR SUPPLY
DPST ON-OFF ON VOLUME CONTROL
A-MOD Ip -200Ma FULL SCALE
B-RF Ig -5Ma
C-RF Ip -200Ma
D-RF OUTPUT
E-"S" METER
SET FOR FULL SCALE WITH I.F. TUBE OUT OF SOCKET
SET FOR ZERO WITH NO SIGNAL
FILAMENT AND POWER PLUG DATA
POWER PLUG - 12 PIN MINIATURE (JONES)
FILAMENT PLUG - 8 PIN MINIATURE
XMTR FIL SW
47-XMIT ON
-25v





was too much for the TNS, speaker and eardrums.

The converterette is a popular version in wide use, but crystal controlled to give the ultimate in stability.

The construction of the receiver section occupies one half the chassis, and conventional parts and wiring techniques are used throughout. BC or 10M reception is switched via a 4PDT slide switch, but a 3PDT would suffice. I made use of the construction of my switch to better isolate the antenna from the BC receiver input when in the 10M position, to cut the BC leak-thru to nil even in my vulnerable neighborhood.

No real difficulty was encountered in the receiver except a tendency of the *if* strip to oscillate when there was no signal present. This was cured by re-positioning the disc ceramic by-pass capacitors on each *if* tube socket to act as a shield betwen grid and plate pins, as well as by-pass other pins. All tube sockets were oriented so as to allow shortest possible input and output leads, with no proximity coupling of parts of input and output circuits.

A bridge circuit was used for the "S" meter between an AVC controlled cathode and a fixed biased cathode. This circuit is non-linear on weak signal readings, but it does give an indication without the need of a separate tube. Pots are shown in the print, but to conserve space, once the bridge was adjusted fixed resistors were substituted instead.

The transmitter rf section uses 3 tubes, with the oscillator and doubler-driver plate coils stagger tuned to give uniform grid drive to the 6146. A voltage drive control allows the 6146 grid current to be kept at proper levels. A minimum of 2½ mils was available across the entire band. The oscillator tube may be VFO or crystal controlled, selected by a 2P3Pos switch. On crystal the frequency may be rubbered a few kc via the VFO tuning capacitor, as the crystal is placed in series with the tuned L/C circuit, effectively locking that circuit to one spot; limited only to the amount the VFO can pull the crystal before oscillations cease.

The VFO coil is a mini-ductor type, with a Plexiglas bar cemented inside it. The bar is bolted rigidly to the VFO-Xtal switch using long screws and spacers instead of the originally supplied screws of the switch. This mounting eliminates the transfer of chassis heat to the coil, and mechanical stability then became the only obstacle to a rock-solid VFO. When the coil mounting bar was bolted tight to the switch, and the chassis and front panel combination bolted securely to the cabinet, and that to the underside of the dash, VFO drift and wobbulation were eliminated. I can now spot the VFO on a frequency from a cold start leaving work, and in the 25 minute ride home an HQ-110 will not have to re-tune me in. Just how selective the HQ-110 is, is not meant to be debated, but I felt it offered a fair average of home equipment performance with which to judge my VFO stability.

I originally planned to neutralize the final, but a back order from the parts warehouse and a moment of courage led me to try it without, and to my surprise the final was rock solid! Further checks proved it to be as stable as originally believed so neutralization was omitted. I had planned to use a .5-5mmfd between 6146 plate and a 3 turn addition to the 5763 plate coil, in case anyone desires a method, or any standard form of neutralization homogenous to the circuitry used will do.

The modulator uses little known tubes to hams, but they are popular in Hi-Fi's. Since 25 watts of audio comes from a ceramic mike and three 9-pin miniature tubes, I felt I achieved my aim in performance and space conservation.

My transistor power supply is a "surplus" GE unit, made available thru GE Ham News. I re-packaged the filter section into a mini-box, so with the heat sink it fitted nicely on the rear of the cabinet. The supply contains a multiple contact relay, actuated by my antenna change-over relay via the push-to-talk mike switch, to change voltages from receive to transmit conditions. Actually, I got the supply first, and then designed the rig to best utilize it. Any home brewer may do well to consider before building that either the rig should fit

the supply, or the supply made to fit the rig. Which circumstance to follow depends on the availability of one or the other, or how easy parts will be to procure for the needs in question. Any of the commercial supplies on the market could be adapted to, as most have bridge circuits which give two voltages, one for receiving and the other for the transmitter, or any combinations thereof as needed.

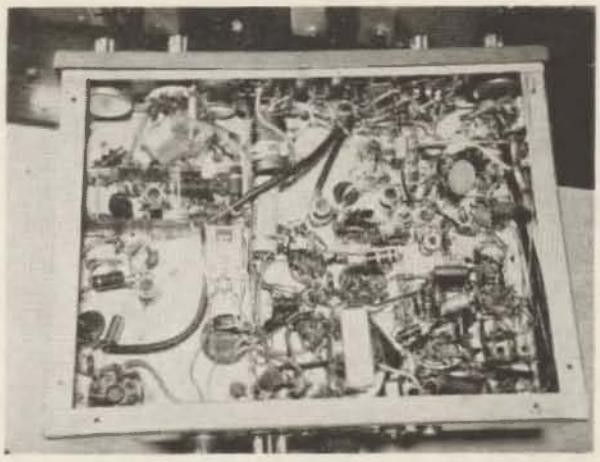
In an effort to further guild the lily, the whole package was wired with provisions to be operated from the 12vdc supply, or an ac supply with 6vac filaments. This was done to facilitate its use at a vacation home or the like without having to hibernate in the car. Not having a use for such features at the present time might make this provision needless work, but this first run model tried to anticipate all needs. Many builders could simplify wiring by eliminating this.

The meter is switched to read modulator plate current, rf grid and plate current, relative rf output, and "S" meter.

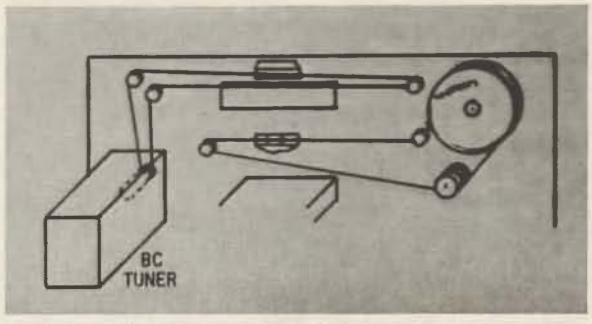
The dual slide rule dial is entirely a home brew effort, and the most ticklish part of the construction in the whole box. The top pointer reads the receiver tuning, with the dial cord patterned after that of the original radio of the tuner. This was secured from a Photo-Fact manual, but with the experience since gained in slide rule dial techniques, I feel it an easy matter to lay out an original.

The lower pointer reads the VFO, and vernier action is achieved by a 2" drum drive turning the VFO tuning capacitor and moving the pointer. The dial assembly is mounted on an aluminum sub-panel behind the front panel. This allows the front panel to be removed without any disturbrance to the mechanism. The dial is made from milk white Plexiglas; India ink marking the lines; and black decal numbers at the appropriate spots. Then the whole affair is sprayed with several coats of clear plastic Krylon to give it a smooth glassy finish. A pilot light assembly is mounted behind the dial, with a second light turned on with the transmitter filament switch positioned so as to illuminate the meter. The meter is a 0-1 ma edgewise reading model, which lends well to the front panel symmetry. The front panel was further dressed up by spray paint, decals and several more coats of clear plastic spray. Aluminum knobs finished the dressing up to the end result of a fairly commercial looking piece of homebrew.

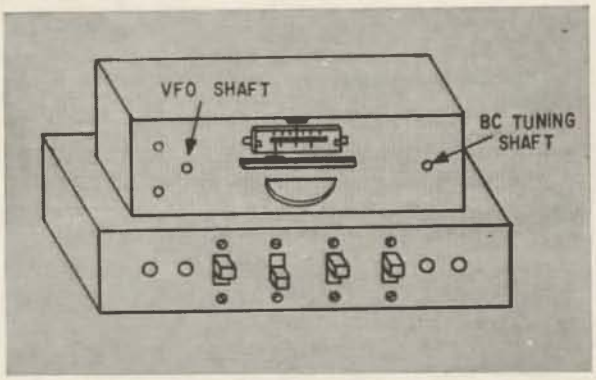
Accompanying diagrams and photos show my layout of chassis and front panel. I believe in a complex effort of this sort very few home brew artists will copy exactly, so detailed wiring and placement instructions might be wasted work. Many will at a glance see little areas of improvement and adaptations of one idea or another to their own desires, and it is hoped this chronology will serve as a stimulus to go and do likewise, and put together



Underside of chassis. Looks like a rats nest, but isn't. Note VFO coil mounting on switch in upper left. Antenna relay space created by modulation transformer above chassis. A copper shield divides the chassis with transmitter rf on one side and receiver and modulator on the other. Shields are used between the oscillator and driver sockets, mounted across each socket.



Dial cord stringing. The dial cord goes around the shaft in the BC tuner four times and then goes through a hole in the shaft and around the shaft again four times in the opposite direction. The knot in the cord is at the pointer clip.



The sub-panel is recessed 1/4" from the front or main panel, which attaches to the chassis via pot and switch nuts of various controls. The screws holding the slide switches are countersunk flat head type so as not to appear on the main panel. Sub-panel has hole cut behind dial for lighting. The top pointer (receiver) rides on the top edge of the sub-panel. The bottom pointer rides in a slot cut in the sub-panel above the meter opening.

what I consider the ultimate in average mobile operations—a one package station that can go from car to car with a minimum of effort, and no need to dig into the car radio, or indeed, no need for that car radio. The effort on my part started four others at WCAU-TV Philadelphia, where I work, on a similar effort, with one on the air and the others still in construction. They are all different in specific layout and design, following only the pattern of a one nackage mobile station.

Many of the parts were on hand in my junk box, but an effort to figure a price tag on everything needed brought the cost to just under $100.00, including the $21.50 for the GE power supply. Many auto radios set you back as much, so I figure even now I'm way ahead of the game, having BC and ham radio too.

The "Hanky Box," as the fellows at work have tagged it, has been in service since June 1960, and performance and reports have all been favorable. I've also home brewed in the same size package a 2 meter station, consisting of a 20 watt transmitter, triple conversion receiver and ac supply, and will endeavor to chronicle its details as the writers cramp eases off.

I also wish to acknowledge with thanks, the advice and photography equipment of K3ADH, Bob Patterson in getting the pictures of the rig

. . . W3GSC

Parts List

Xmt Fil Sw—SPST slide switch.
RFC—Filament hash choke, supplied with GE transistor supply.
Antenna Relay—6 vdc coil Advance AM/2C/6VD Miniature Antenna type. 6 v coil is used so it is OK for rectified 6.3 vac when used at a fixed location. AC supply then does not need dropping resistor R1, only M500 rectifier and 1000 mfd electrolytic to give dc.
12 pin power plug, filament jumper plug, coax antenna receptical, mike jack and speaker phono plug all mount on rear of chassis.
Transistor supply, consisting of heat sink and mini-box mount on rear of cabinet above opening where chassis connectors come out.
T1-T2—Miller 455 kc *if* input xfmrs **12C1**.
T3—**Miller** 455 kc *if* output xfmr **12c6**.
T4—Audio output, 5K to 3.2 ohms.
L1—⅜" LS5 form. 17 turns #24 enam. Link 2 turns hookup wire on cold end.
L2—⅜" LS5 form. 15 turns #24 enam.
L3—¼" LS6 form. 10 turns #26 enam.
L4-L5-L6—See text.
L7—⅜" dia slug tuned. 28 turns #24 enam. Resonate to 14.5 mc.
L8—⅜" dia slug tuned. 12 turns #24 enam. Resonate to 29.3 mc.
S1—Ceramic 2P3Pos VFO-Xtal switch.
S2—DPDT slide switch: VFO spotting, one side wired to break push-to-talk circuit in spotting position.
R1 & R2—Wirewound shunts to permit O-1 ma meter to read 200 ma full scale.
T5—1:3 Audio interstage transformer.
T6—30 watt modulation, UTC S-19. 8K pri to 3700 ohm sec. Modulator current rests at 75 ma, peaks at 115 ma. RF amplifier current loads to 115 ma.
L9—8 turns 1" diameter 1" long (**B&W**) #3014, Illumitronic 808T).
All capacitors are disc ceramic unless otherwise marked. Where polarity is shown use electrolytic, values are in mfd.
All resistors are ½ watt unless marked.
Rig is attached to underside of dash with bolts and heavy guage aluminum angle.

Eye Catching QSLs

at reasonable prices

Frank Whitmore W2AAA
223 West Holly Avenue
Pitman, New Jersey

How would you like your QSLs to have: Eye-catching appeal at reasonable prices? Modernistic designs fresh from the theme of world events? Exciting scientific pictorials dripping with realism? A little pooling of interest makes all these things possible. The secret—organization!

Behind beautiful printing lies artwork. However, pretty pictures alone do not constitute artwork. Good artwork satisfies a purpose. The purpose controls the theme. And the theme weaves the art and end-use together.

Artists don't measure costs by mechanical methods. The artist charges according to what the job looks like. Being custom made, art remains high like the services of most professional people. If the finished art looks like twenty-five dollars, twenty-five dollars becomes the price. If, on the other hand, the piece looks like three-hundred dollars, that becomes the charge. Commercial art prices resemble a surgeon's fee—after looking the patient and the situation over, he arrives at the amount.

To get good art cheaply; organize. Many hams belong to radio clubs. Some belong to special clubs featuring one particular facet of amateur radio. All such memberships are "naturals" for low-cost call cards. The type club itself doesnt' matter; just so it represents some ham association. Such clubs afford excellent opportunities to obtain significant, economical designs that establish their members.

By selecting a club design appropriate for the club yet individual enough for each of the members, the high art cost spreads out over

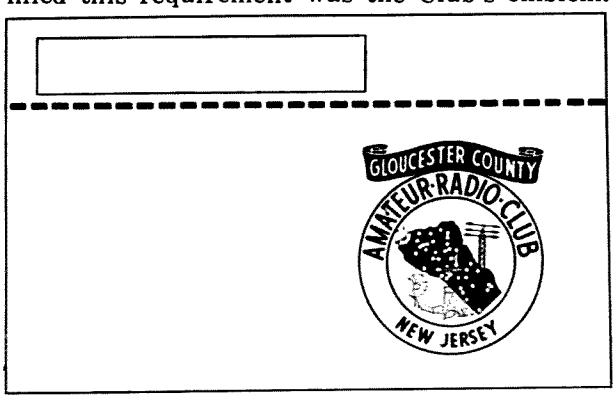
a number of contributors. It's the same principle used by insurance companies—everyone chips in a little to painlessly build up a total that easily takes care of everybody. If fifty hams belong to a radio club and an artist charges fifty dollars for two color separation artwork, the cost to each amateur is only one dollar.

Now one thing immediately becomes evident —every member subscribing will get the same QSL design. Everything remains the same except that each member's cards will contain his own call. However, if your radio club membership totals several hundred, the club does not have to freeze on one design. They could use numerous designs. One might portray the basic overall club; another, the mobile portion; another, a certain band activity; etc.

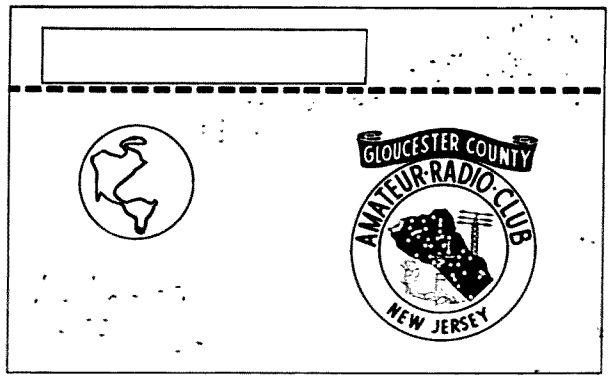
But perhaps you object to having a call card just like another's. You see plenty of this sameness in type-printed cards sent out by the ham fraternity today. You prefer as much individuality as possible. Let's see how one amateur club handled this problem in their ranks.

WA2NGI, the Gloucester County Amateur Club in southern New Jersey, wanted a snappy call card. While they desired a QSL to strongly represent them, they also wanted it to fit modern scientific times and to show affiliation with the ARRL. On top of all this, they preferred a club card that every member could use by substituting his call for the Club's. Out of this stack of requirements the artist charted a course.

A club card should predominantly represent the club. Therefore, the artist sought something that would highlight this feature. Was there any one thing he could use as a distinct symbol? Call letters wouldn't do because though individual, they are also abstract; they convey no identity to the individual when they stand alone in printing. The logical thing that filled this requirement was the Club's emblem.



Using the Club's emblem as the highlight meant the call letters must be secondary—a design won't support two highlights of equal intensity. The artist met this condition by keeping them small but prominent. To gain this effect, he divided the card into a large and small area by using a bold dashed line. At one of the four main interest points in the



large area he placed the Club's emblem. In the left half of the small area where it wouldn't distract from the highlight, he left a small blank space for imprinting the call letters. See Fig. 1.

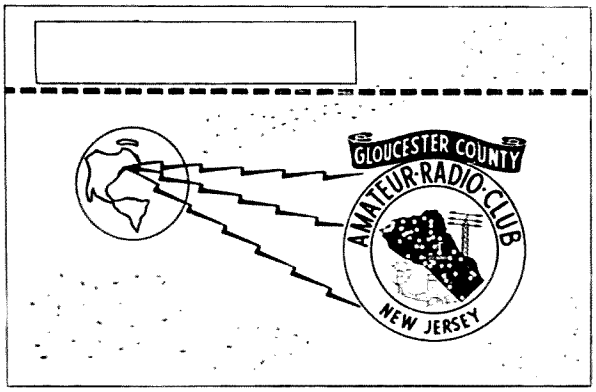
So far the design showed only two planes—horizontal and vertical. Now the artist considered depth. Three choices faced him at this stage in the design: He could place the symbol in isometric third dimension (all lines parallel to their opposites); use artistic perspective to create a large shadow cast by the emblem and fading into the field color of the card; or, leave the emblem in two dimensions but hanging aloft in third dimension space.

The artist selected the third possibility. By choosing this method he also satisfied the requirement of the Radio Club for a modern scientific scene. Proceeding from here he placed a medium-sized Earth at the upper left-hand highlight point. Below the Earth and extending above the emblem into the region above the dashed line, the artist scattered stars. This produced two effects: It gave a feeling of outer space to the Earth and it tied the small area above the dashed line to the basic design. See figure 2.

Now let's sum up what we have. The big Club emblem satisfied the requirement for highlighting the Radio Club. The Earth and stars portrayed the scientific space age of today. But so far no relationship existed between the Radio Club's emblem and the outer space scene. And certainly no excuse existed for showing the two things side by side. In other words, *no theme existed.*

What could the artist do to merge the two separate thoughts expressed at this stage in the design? What excuse existed for the emblem being out in space? If the artist stopped at this point, about the only thing you could say was that the Gloucester County Radio Club was "up in the air"; or, be polite but indefinite and say, "it was out of this world."

To tie them together, the artist drew some lightning flashes from Earth to the emblem. However, signals from anywhere on Earth illustrated no special meaning for the Radio Club. So the artist did a final thing; He arranged the signals connecting Earth to the emblem so they emanated from one place on the map—the approximate location of the



Club. That addition immediately solved the theme problem. *It gave the Club a definite location in space.* See Fig. 3.

Next the artist changed the broken separator line from a dash to a dot. This alteration injected a mildness more pleasant to the eye. At the same time he drew in the ARRL symbol in the lower right-hand corner. By keeping the symbol small, he controlled identification with the League without distracting from the overall design.

The one remaining problem concerned use of the card by the membership. As the design now stood, anyone's call letters could appear in the blank space allotted. However, imprinting various calls on the basic QSL card would make it appear that the Club possessed many calls. The design still lacked firm identification for Club members.

Solution of this final problem proved easy for the artist. And it didn't require any change to the design. He accomplished it by calling for the words "MEMBER OF" to be printed in small letters below a Member's call at the time of imprinting. This simple treatment solved member identification beyond a doubt. See Fig. 4.

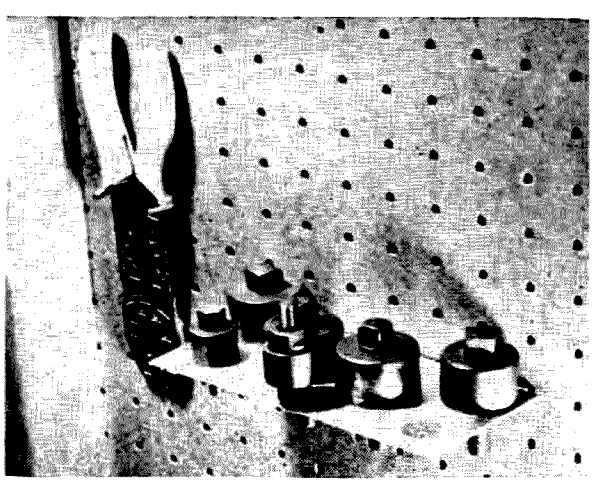
The final cards print in blue and yellow. Blue forms the field of the card and some of the lettering in the emblem. The emblem background and the lettering in the ribbon take yellow. The continents get blue with the Earth outlined in blue and yellow. White from the card stock forms the dotted line, lightning flashes and ARRL symbol. And a very light blue produced by the screened portion of the printing plate fills the area left blank for the call letters. The printer first runs a bulk quantity of cards for the Club. The Club sells the cards to its members who arrange with the printer to imprint their calls plus the words "member of" in the blank space on the card.



Membership in a radio club offers numerous advantages. To the amateur it gives stature in the community; to the community, a ready, organized service should disaster strike. For hams who enjoy club membership, club QSLs offer great appeal. And, this opportunity to get a pretty QSL reasonable is just one more service amateur radio clubs extend to their members. To get the best for less, investigate the radio club in your area. . . . W2AAA

Knockout Punch Storage

Adequate storage of tools is always a problem in the home workshop. Use of wall mounted "peg-board" and the variety of special hangers and fixtures now available simplifies the task but there are many commonly used tools that do not lend themselves to this treatment. Knockout punches fall in this category.



A metal shelf peg-board accessory, manufactured by The Kerr Wire Product Company, Chicago 51, Illinois and available in most hardware stores, is easily modified to meet this requirement. The shelf, shown in the photograph, measures 3" x 6½" and will accommodate a number of knockout punches of the Greenlee type. Lay out the punch locations on the shelf plate and drill pilot holes for the punch drive screws. Punch the holes, mount the shelf on the peg-board and install the punches.

The punches are easy to find when needed and storage is neat and secure. Tube socket test adaptors mount just as easily, as do a host of other commonly used tools and test accessories. . . . W4WKM

Investigating 2N169A

Vladimir Gercke K6BIJ

THE G.E. Transistor Manual gives us a page of useful information on 2N169A. Let's see: "DC Characteristics," "Low Frequency characteristics," here we are—"High Frequency Characteristics 455 kc"; gosh,—since when is 455 kc high frequency? But we have nothing else, so we have to use this column.

From it we learn that 2N169A operating on 455 kc has a "cutoff frequency of 9 mc"; also we learn that this interesting event takes place at 25 degrees Centigrade. So, I guess, after carefully reading the whole page of the Manual, we can very definitely assume that our 2N169A is most probably a transistor. Thank you G.E.

Let us try another approach.

The simplest form of a regenerative broadcast receiver using 2N169A will take form of Fig. 1. L1 here is a loopstick and some sort of transistor audio strip will give us a speaker volume.

We start taking turns (a few at a time) off the loopstick, and see what will take place. Two things happen: the floor begins to look as if a french poodle just had a haircut, and receiver frequency goes up. It works on 160 meters—good. It works on 80—fine. It oscillates merrily on 40—excellent; this must be the end, as G.E. said something about 9 mc (not sure what). But it works on 20 with only 3 turns left (we are trimming the tickler too); changing C2 to 25 mmfd and raising the voltage to 9v—it works on 15 meters. L1 is now a ½" plastic coil, iron slug tuned, and has only 2 turns #18 (5 #24 on a tickler), 365 mmfd condenser is all "out," and we are using "gimmick" to couple the antenna. 2N169A quits oscillating shortly after 15 meters, but if you have a handful of them—some will go to 10 meters.

Now we are going to try something rather unorthodox: with 2 turn coil, we will attempt to go as *LOW* in frequency as we can. 2N169A works good thru the range of our 365 mmfd condenser and brings us to about 10mc. We hook up two more 365's in parallel and get to about 8 mc. A 3000 mmfd silver mica is now added to the existing capacity; it cannot possibly oscillate (losses too high, too much "C," not enough "L")—but it works, and right in the 40 meter band.

This is getting ridiculous, but we add another handful of silver micas, totalling about 16,000 mmfd (.016 mfd)— and find ourselves on eighty meters.

In desperation a .1 mfd bathtub paper condenser is soldered across everything we had thus far,—and we hear a commercial from a BC station. Nuts . . . Oh, no . . . my transmitter power supply filter stays where it is now,—*you* try it.

To make the bathtub work—we had to change C2 to 500 mmfd and add a lot of turns to the tickler, but L1 still has 2 turns. (iron slug *must* be all in).

So much for the "pure science" department. Now what good use can we put this contraption to? Let us try it as an 80 meter receiver. The 365 mmfd variable (plus some 16,000 fixed) covers only about 10 kc, it gives perfect bandspread, but to cover the band we must use the slug. Antenna (80 meter transmitting, 70 ohm coax feeder, is inductively coupled using one turn coupling coil.

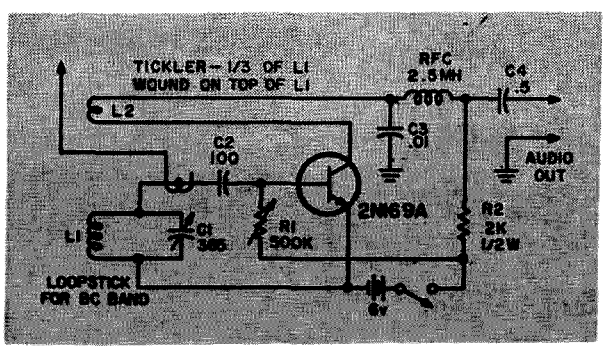
It becomes apparent at once—the receiver has an unusually good SELECTIVITY, better than some communication receivers in the cheaper class. SENSITIVITY, using resonant antenna, is good. STABILITY is perfect. It works on AM, CW, SSB, and does not know what an image is; regeneration is very smooth. Generally it makes a very acceptable communication receiver with two IF's (IF here is "if," not Intermediate Frequency).

1. If you don't have a very strong local signal; if you have one—you will hear it, no matter what frequency it is on. I sometimes hear planes flying overhead. Radar too.
2. If you don't mind readjusting the regeneration control each time you go a few kc off your last frequency.

Some theoretical info on where the extra selectivity comes from must be obtained and published. Further experimentation should include: Other transistors, rf stage, use of Varistors for tuning.

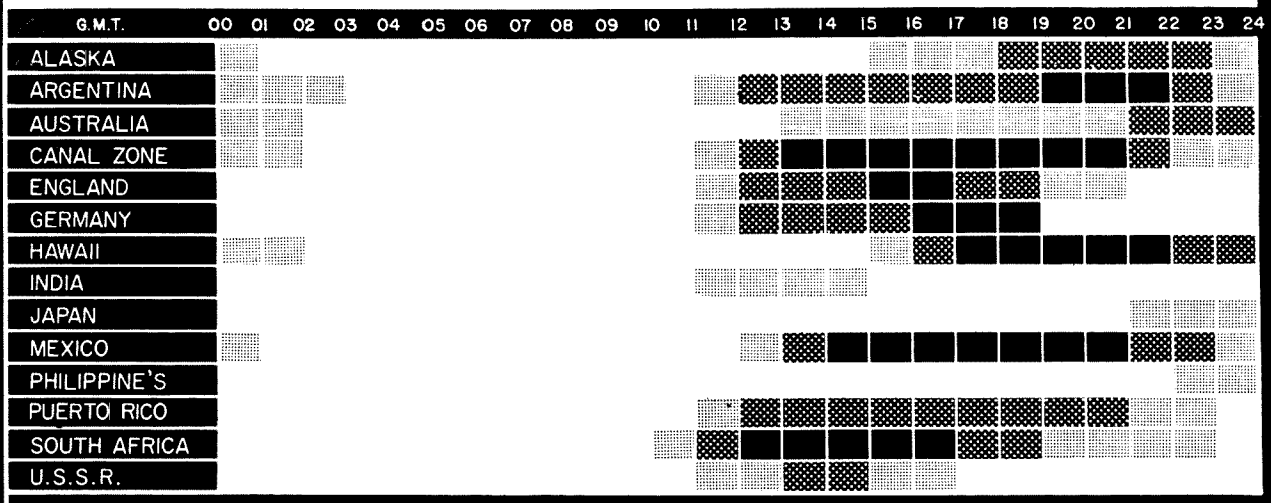
One other use is apparent at this time—as a "Zerobeatnick."

. . . K6BIJ

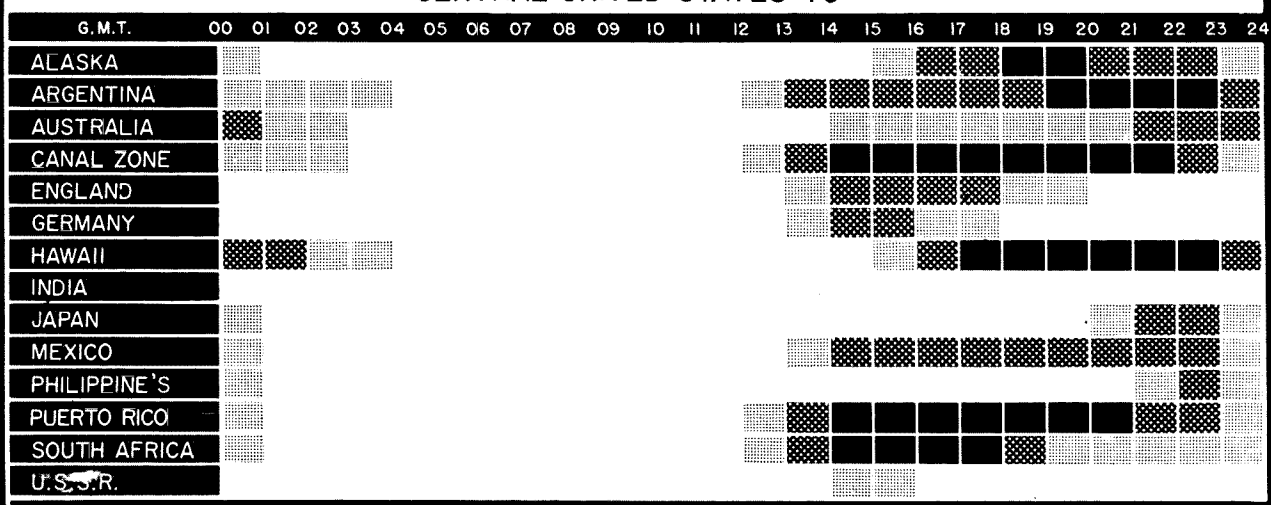


PROPAGATION CHART

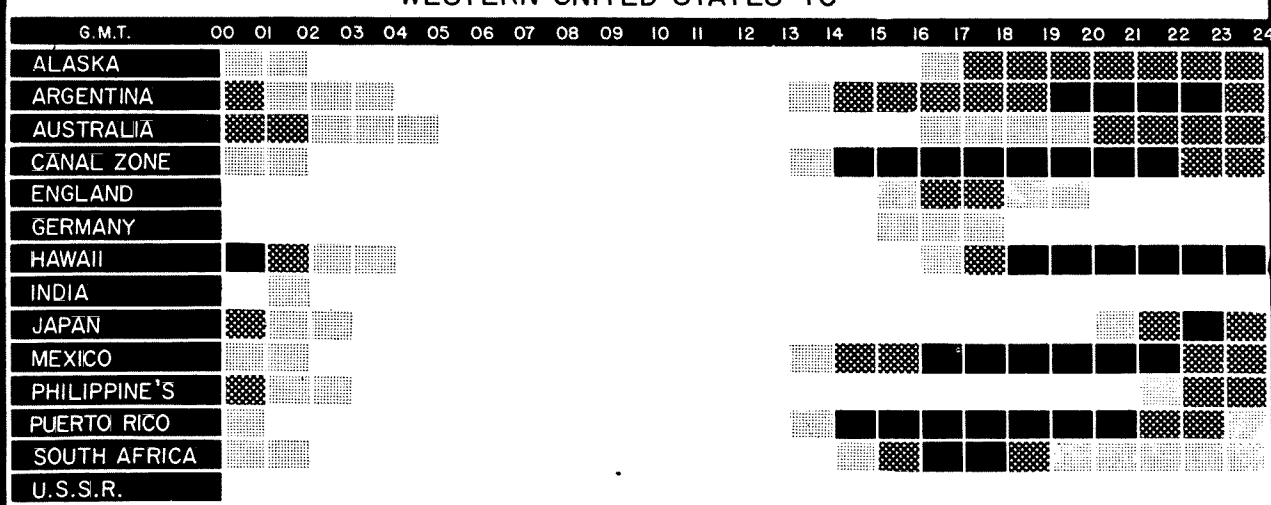
EASTERN UNITED STATES TO:



CENTRAL UNITED STATES TO:



WESTERN UNITED STATES TO:



LEGEND 7 MC 14 MC 21 MC 28 MC

Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

Advance Forecast: January 1962

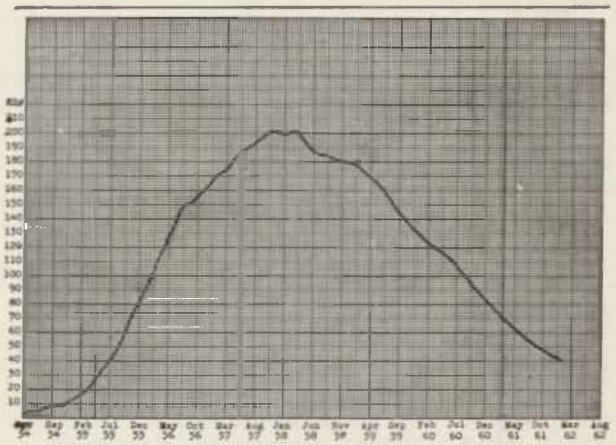
Good: 1-18, 20-21, 27-29

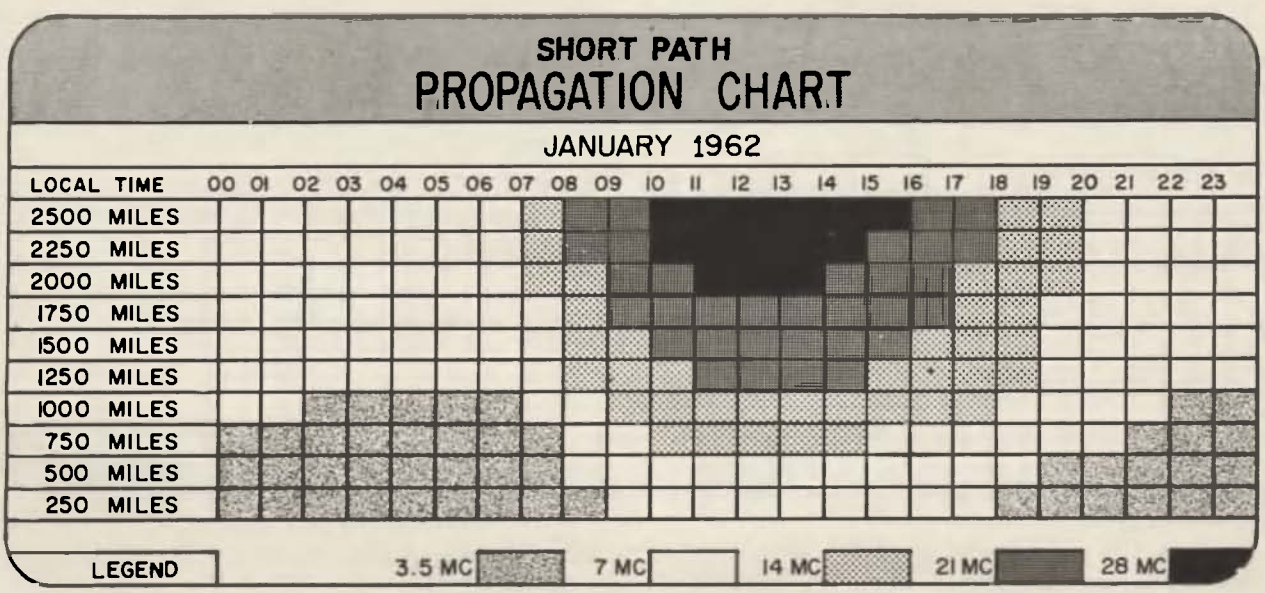
Fair: 19, 22, 26, 30-31

ugh: 23-25

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HB to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

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QRN

and the battle to beat it

THIS is being written not as a story to tell you how I whipped my own QRN problems, but as a guide to help you identify and track down the obnoxious nerve-wreckers covering *your* receiver.

In my search for the snaps, buzzes, snorts, and choggles which loused up many a fine DX QSO, I lost a lot of sleep roving the streets while the noise was on. I have been accused of being a nut, roving the streets in pajamas, armed with the tools of the noise hunter. Nonetheless, our record for finding and eliminating QRN stands at 100%. "Our" being myself and my invaluable helper & son, Steve, WA6IVN.

A look at the various noises encountered: There are those which are seasonal such as heating pads, electric blankets, electric heaters, defective thermostats, swimming pool heaters, etc. Heating pads and blankets follow a pattern, starting about 10 pm ending about 8 am, so *time* pretty well pin-points these noisy devils.

But before proceeding, let's look at a few definite needs:

1. A notebook to keep your notes regarding the times involved for your particular QRN, and to keep a record of the area searched, and other noises which are found, but not bothersome at the time. (When you read over your page of notes, the picture becomes much clearer!)
2. A hand-drawn or printed street map of your area to keep track of what you found and where you looked.
3. A single-bit axe or sledge hammer. (Down, boy! This is for research purposes only.)
4. A small transistor radio (indispensable).
5. Car with radio.

Begin by keeping a record of the noise, time of starts and stops. If it is intermittent, a description of it. If you have a beam, an indication of the general direction from which the noise is received. In your hunting, you will probably run across other noises. If they don't match the one you are hunting, simply file them for future reference. Heaters and furnaces generally will be heard in the morning and evening hours with an odd exception or two. Swimming pools in the daytime, the seasons being obvious.

Under nocturnal noises, we have the inevitable heating pads used for illness (*usually* at night). A very hard nut to crack is the 2 KV series street lighting, characterized by their on-at-dusk, off-at-daylight pattern.

After-daylight QRN can be varied. Generally, it is motors in factories, dental laboratories, medical offices, and homes. Don't overlook the do-it-yourself fiend with a complete QRN factory in his garage or basement.

Last, not least, is the steady stuff—really ham-maddening! Power leaks really aren't too hard to find. They sound somewhat like a basso profundo gargling—24 hours a day. This can be worse in coastal areas where insulator salting is a problem. Once the offending line is located, a call to the power company will usually result in the insulators being sprayed from trucks which the power company has for this purpose. Another excellent cure, when answered, is to pray for a monsoon. Other 24 hour QRN includes refrigerator butter warmers and defective bell transformers.

We have yet to mention fluorescent and slimline lighting fixtures. These often betray themselves by their on and off times (I hope the idea of the notebook is beginning to sink in). Still in the 24 hour category are the bad ones, defective grounds and wiring; they are the most difficult to locate.

The time to hunt QRN is when you hear it. If you wait till it's more convenient, it will probably not be there. If a power leak begins at 1 am, if you have a beam, use it to obtain the general direction the noise is coming from. A line on your map indicating this direction will save you time in searching streets not affected. (I've been stopped by the police in my pajamas, an axe in one hand and a transistor radio in the other. I was suspected of chopping down a power pole.)

Heating pad noise also has to be hunted at night, located, and doorbells rung the next day.

Fluorescent lights are best hunted during the evening hours so hunt them relatively early as they usually go off about 10 or 11 pm. (Bedtime?)

The back breaker, defective grounds and wiring can be searched for at any time. However, don't fail to take note of wind conditions indicating exterior wiring or grounds or guy

wires.

Let's make a typical search. Supposing we have deduced from observation that a heating pad is involved. We have established the direction as being north of your QTH. As a rule, S-9 indicates the noise is within 600 feet. A reading of S-3; up to about 1500 feet; will give an idea of the distances to be searched. Now then, using the car radio, gain full on and tuned off of a station, proceed for a distance of at least six blocks, or 1800 feet. Do this as follows:

Be sure to stop at each corner and in the middle of each block or equivalent, with a wait at each stop equal to the off period of the QRN we are looking for. On the map, indicate the route you have covered noting other QRN found, by notes on the map. As you criss-cross your search area, you will suddenly be rewarded by having the car radio pick up the noise. Drive along as close to the power lines as possible until the noise reaches a maximum. Stop the car slightly beyond this point. Taking the transistor radio with you, walk back to the loud point. Standing on the sidewalk and holding the transistor **radio at** arms length, point it at the opposite side of the street about 100 feet to your left. Slowly sweep through an arc with the radio to a point 100 feet to your right. If there has been no positive indication, cross the street and repeat this process. The transistor radio will point to the house with unerring accuracy indicated by a sharp build up in volume. Note the address and go back to bed.

Now, if no noise was heard on the transistor radio when used as described above, you still are not at the right place. This means you must follow the power line and each power line fed or tapped off it for a radius of about 1500 feet from where you made this initial test. Eventually the transistor radio will hear the noise at one of these nodes, and you have arrived! Remember, even if it is loud on the car radio, if it is not audible, or very weak in the transistor radio, you are *not* in the right place! I had to learn this the hard way.

The following evening after the dinner hour is over, ring the door bell of the house in question. *Do not identify yourself as a ham!* Rather, state you are trying to find some interference which is ruining reception of AM or your Hi Fi radio, and that you have localized it to this immediate area after many frustrating hours of search. Ask if they have a heating pad, an electric blanket, or a thermostat controlled electric heater which is normally used at night. Ask if they have noted static in their radio (usually ac-dc). Try to be concerned about their welfare, pointing out the danger of a pad with arcing thermostats. As a result, usually they will allow you to check everything in the house. Don't forget it takes about fifteen minutes from the time it is turned on for a pad or blanket to act up. Enjoy their hobbies and conversation while you wait. As soon as the noise begins, using the transistor radio to monitor, pull the main switch momentarily. If it stops, it is on the fuse side of the line. Then unscrew one fuse at a time until the proper circuit is located. An investigation of all the lights and plugs on this circuit will disclose the culprit. Thank them kindly for their help and proceed to the nearest appliance shop and purchase a pad with nonradiating thermostats. The following evening, with surprising ease, a trade can be made and the culprit should be taken to a remote place and hacked to bits. In the case of an electric blanket, convince them it shouldn't be used as it is, but should be returned to the dealer for repair or replacement.

Let's go to the power-line leaks. A real bona-fide leak goes at it continuously. This is indeed a break when hunting for it. The intermittent variety may be a little more difficult, but the same search manner is to be followed. Remember this, though, if it is a sunset to sunrise noise, it very likely is street lighting and the initial search should be confined to the poles that hold the lamps. In cities this is usually the 2 KV series lighting and is capable of considerable racket. Even if you hear it on every pole with your car radio you will not be at the right one unless you hear it at strong volume on the transistor radio. The search for power noises invloves following the line and its branches at least one-half mile in each direction from your house. Don't fail to observe trees which could cause intermittent windy-night QRN. Walk to the pole nearest the tree, and a healthy whack or two at least four feet up from the ground will cause a sputtering if there is any potential QRN here. It should be noted in the book and spotted on the map. Eventually, as you proceed along power line after power line checking with the transistor radio, you will locate the pole. Now, attack the pole with ten or twelve lustry blows with the back of the axe or sledge. Should a reaction occur, notify the power company as to the pole number and location. If no reaction occurs such as sputtering at the moment of impact, take note of any feed line coming from this pole and check each one with the transistor radio. One such line will be it. Most people think the transistor radio was intended for entertainment. "They're daft, man, daft!" Incidentally, the axe treatment will show up insulator tie wires which are radiating noise. These are very rough ones to find requiring banging each pole along the way with the axe. I reiterate, if you don't hear it on the transistor radio at good volume, regardless of an apparent node in the car radio, YOU HAVE NOT ARRIVED! Don't tap the pole, vent your fury on it! *There is no feeling of joy so profound as to hear a break in the noise as you gleefully bash the pole.* From this point, the power company will take over, usu-

ally with quick response.

The salt problem in coastal areas is quite easy to solve. The transistor radio will again quickly point out the offending high voltage transmission line. Again, the cure is to notify the power company. They will soon have trucks out to wash down the insulators. The axe treatment will also take care of poor branch line joints such as loose splice connectors hidden under miles of tape.

We have come to the last item on this list. It is by no means the last known QRN. (Unless 73 wants me as a full time writer for the next five years, I can cover only about 85% of possible noise-sources). These are the defective grounds and poor wiring. First, let us look into defective grounds. These commonly consist of the grounded conductor of the house electrical system and its bond to a cold water pipe. If this bond is not excellent, any appliance, motor or fixture which has a leakage path to ground can cause QRN. The transistor radio again will be of invaluable help and will detect the poor ground when same is shaken with vigor; like—*with a dry glove on the hand doing the shaking.* A severe shock can result if the ground is broken, even momentarily while it is being shaken.

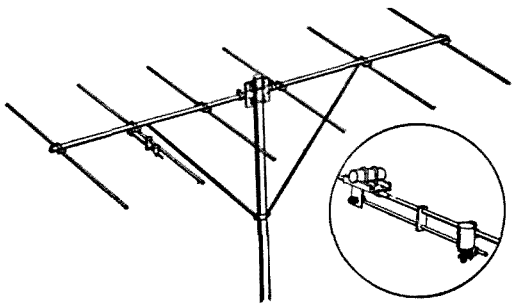
Also, don't overlook the lowly bell transformer which also lights the house numbers. The most frustrating twenty-four hour of QRN I ever contended with was finally located as a defective bell transformer two blocks away. After locating the home, and explaining what was happening to my "Hi Fi," this very cooperative home owner allowed me to spend two hours in his house eliminating item after item, using the transistor radio and unscrewing fuses one at a time until the offending circuit was found. There my headache began. I started by pulling the plugs from all the outlets on this circuit. When this didn't help, I asked permission to take down the fixtures. My startled home owner dazedly allowed me to do this. When this didn't help, I removed each plug from its wall box and inspected it. Still no luck. So giving up in disgust, I put everything back together; and as I was leaving he said, "Did you make sure the door bells are working?" It took me exactly ten seconds to cut one lead to the bell transformer and the noise was over. A new bell transformer cost me $1.80 which I presented to the home owner and installed with joy.

Don't forget guy wires: Your own antenna tower, TV antenna mast, and occasionally power line guys. Whenever a guy wire is not insulated from ground and some sort of a connection exists, a bonding wire must be soldered across the joint. Static build-up will discharge across such places after they have become sufficiently weathered and corroded. TV antennas are terrible offenders when haphazardly guyed to metal flashlights, water pipes, sewer vents, or drain pipes. Due to the



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fact that most TV sets are operated ungrounded, any leakage to ground then goes by way of the TV mast, guy wires, and metal flashings whose joints usually are not electrically serviceable. Static discharge on this item is also the source of some fine noise, but it can be beaten. My experience with this points to the fact that to be objectionable, it must be within 300 feet of your receiving location. There may be remote exceptions to this.

Remember, QRN hunting takes time. It must be done with a plan. It will involve notes on paper and on your map, sleepless nights, and hours of unrewarding search. Nevertheless, the rarest DX you have ever worked won't thrill you half as much as the day you nail your own QRN problem.

To date I have replaced two defective fluorescent fixtures, one bell transformer, fixed four poor grounds (one in my own guying system), bought and traded three heating pads for defective ones, fixed one arcing blanket control, bypassed one fish tank thermostat, taken down two rusted and corroded TV masts and guy wires, and furnished one indoor rabbit ears free to one of the owners.

I have been a ham for two years. The total expenditure to cure various QRN has been about fifty dollars, which adds up to about $2.00 a month. Very cheap indeed, for a hi-fi (translatable as "DX") fan.

GOOD HUNTING! . . . WA6IVM

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With the expenditure of about one dollar and a few hours of labor, owners of Heath VTVMs can make their instruments 100 per cent easier to calibrate and use. The VTVM illustrated is a Heath V-7A, but the changes are applicable to many popular brands of meters.

Step one is to take the manufacturer's calibration instructions out of that dusty closet and get them attached to the meter case where they belong. Few owners could accurately recite the correct order of the calibrating steps, and as a result calibration suffers. Typewrite the specific steps for calibrating your instrument on a file card cut down to fit the side of the meter case. Mount the card using the new Mystic brand transparent plastic tape. This tape will not dry out or peel.

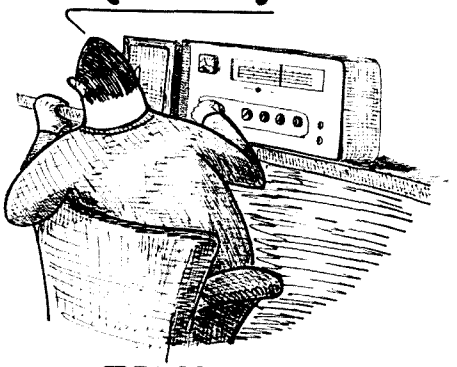


Step two is to make the calibration controls easily available without the bother of removing the case. Drill three holes, each a little more than ¼ inch in diameter, in the back of the case. Carefully align the drilling marks so that the holes will be in line with the calibration pots. Press a wide strip of adhesive plastic tape (white) into place below the three holes. With an instant-drying marker pen, label the access holes according to function.

Step three is to provide a calibration tool, and a place to store it. Purchase a short length of bakelight or plastic rod, ¼ inch in diameter. Such material is shown in all mail order catalogs. Using a file, dress one end of the rod until you have a screwdriver-shaped tool. Mount a regular fuse clip on the back of the instrument case, and slip the tool into place.

Step four is to provide escape from tangled line cords. Remove the instrument case and detach the line cord from the power supply. Drill and file a hole in the metal bracket that originally held the line cord grommet, and install a recessed male TV power connector. Using a portion of the old line cord, wire the TV connector leads to the power supply. Enlarge the power supply cord hole in the instrument case to provide clearance for the TV connector bolts, and reinstall the meter assembly in the case. Plug in a regular TV set cheater cord, and you have a convenient means for removing the power supply cord completely. This is especially handy when moving or storing the VTVM. . . . Bentley

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Look at Fig. 1(a). Here R_s is the resistance of the screen itself (ratio of dc screen voltage to dc screen current), E is the no-load voltage of the screen supply, and R is the internal resistance of the screen supply. Where an ordinary series screen dropping resistor is used, E would be the plate-supply voltage and R the series resistor. Now let us cause the screen resistance R_s to vary (by changing amplifier loading, say) and see what happens to the screen dissipation P_s. The curve in Fig. 1(b) is a plot of screen dissipation versus screen resistance, with supply voltage and supply resistance held constant. It shows that the screen is hottest when the screen resistance is equal to the internal supply resistance. This result, of course, is predicted by the maximum power transfer theorem—we have "matched impedances." Notice that since the current through R and R_s is always the same, the voltage drops across them will be equal in the matched condition.

Suppose we have a single 807 in a class C plate-modulated final. Plate voltage is 600 volts, and the tube manual says to run the screen at 300 volts and 8 ma. A series screen dropping resistor will then have to drop 300 volts at 8 ma. A 37.5-kilohm resistor will do it. The screen is evidently "matched" to its supply (equal voltages on the screen and the series resistor). A change in tuning, drive or loading may change the screen resistance, but it can never increase screen dissipation because P_s is already at the peak of the curve in Fig. 1(b).

Now consider a stage using a single 6146, again class C plate-modulated. Plate supply is 600 volts, and the screen is supposed to draw 7.8 ma at 150 volts. A series resistor from the B— plus would have to drop 450 volts. The internal resistance R of the screen supply would be the dropping resistor, 450 v/7.8 ma = 57.75 K, whereas the screen resistance R_s is only 150 v/7.8 ma = 19.25 K. The screen would then operate well to the left of the peak of dissipation in Fig. 1(b), so any increase in screen resistance would make it heat up. There must be a better way.

We would like the screen supply to have a no-load voltage of twice the screen voltage, or 300 volts, and an internal resistance equal to the normal screen resistance of 19.25 kilohms. Then the screen dissipation will never rise above the operating value.

A properly-designed voltage divider across the 600-volt supply can do just that. To see how, we need another result from network theory—Thevenin's theorem, which states that any linear network, no matter how complicated, is equivalent to a regulated voltage source in series with an impedance. The voltage of this source ("Thevenin generator") is equal to the no-load voltage of the actual network. The series impedance ("Thevenin impedance") is the same as the impedance seen looking into the actual network terminals with all voltage sources short-circuited.

Let us apply Thevenin's theorem to the voltage divider in Fig. 2(a). It is a 2 to 1 divider, so the no-load voltage at the terminals is half of 600 volts. That is, the Thevenin generator is 300 volts. To find the Thevenin impedance, short-circuit the 600-volt supply and measure the impedance looking into the terminals. We see two 38.5 K resistors in parallel, or 19.25 K. The circuit of Fig. 2(a) is thus completely equivalent to the simpler circuit of Fig. 2(b) as far as any measurements at the terminals can tell. This then is the screen supply we

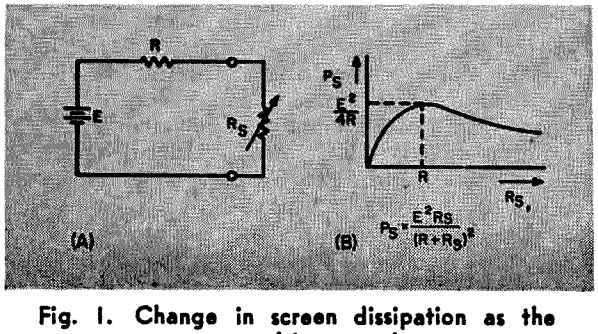


Fig. 1. Change in screen dissipation as the screen resistance varies.

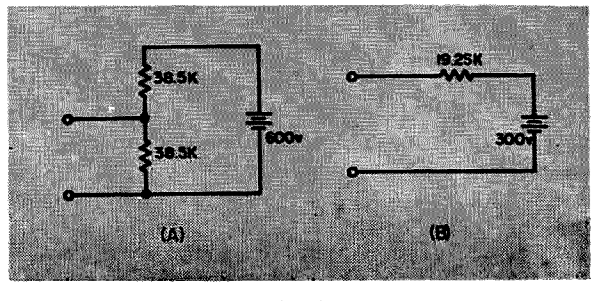


Fig. 2. A voltage divider and its Thevenin equivalent circuit.

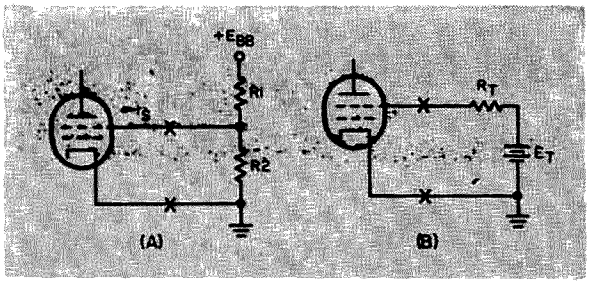
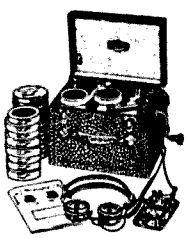


Fig. 3. Screen divider and its Thevenin equivalent, used in deriving equations (1) and (2).

were looking for to protect the 6146 screen.

In any amplifier where the desired screen voltage is less than half the plate voltage, a divider can be designed so the screen dissipation can never be increased by mistuning. We will now derive some simple formulas for the divider resistors. If you don't care to follow the algebra, just skip down to the results, equations (1) and (2) below.



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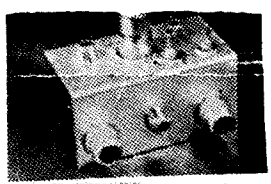
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Symbols used are these: E_{bb} is the plate supply voltage, E_s is the desired screen voltage, I_s is the normal screen current, R_1 and R_2 are the divider resistors shown in Fig. 3(a). Looking into the divider at points XX, we want the Thevenin generator to be twice the screen voltage. That is,

$$E_T = E_{bb} \frac{R_2}{R_1 + R_2} = 2 E_s$$

We want the Thevenin impedance to equal the screen resistance, or

$$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{E_s}{I_s}$$

These two equations can be solved simultaneously for R_1 and R_2, with the result

$$R_1 = \frac{E_{bb}}{2 I_s} \qquad (1)$$

$$R_2 = R_1 \frac{2 E_s}{E_{bb} - 2 E_s} \qquad (2)$$

A divider using these values for R_1 and R_2 makes it impossible for the screen dissipation to increase when the stage is misadjusted.

To show how the formulas are used, we will design the divider for the 6146. Here E_{bb} = 600 volts, E_s = 150 volts, I_s = 7.8 ma. Then

$$R_1 = \frac{600 \text{ v}}{2 \times 7.8 \text{ ma}} = 38.5 \text{ K}$$

$$R_2 = 38.5 \text{ K} \frac{300 \text{ v}}{600 \text{ v} - 300 \text{ v}} = 38.5 \text{ K}$$

With zero screen current, the divider output is 300 volts. When the screen draws its rated 7.8 ma, the voltage falls to 150, so 450 volts appears across R_1 and 150 volts across R_2. The power dissipated in R_1 is E^2/R, or $(450)^2/38{,}500 = 5.26$ watts. The power in R_2 is $(150)^2/38{,}500 = 0.585$ watts. In practice one would use a 39 K or 40 K 10-watt wirewound for R_1 and a 39 K 1-watt carbon for R_2.

The one disadvantage of using a divider instead of a simple series resistor is that a little more current is drawn from the plate supply. The total drain flows through R_1, and (in the case of the 6146) by Ohm's law this current is I = 450 volts/38.5 K = 11.7 ma, which is 3.9 ma more than the screen current alone. If the stage is plate-modulated, the modulator will have to supply 600 volts x 0.0117 amp = 7 watts to the screen circuit, instead of 600 x 0.0078 = 4.7 watts if a series resistor alone were used.

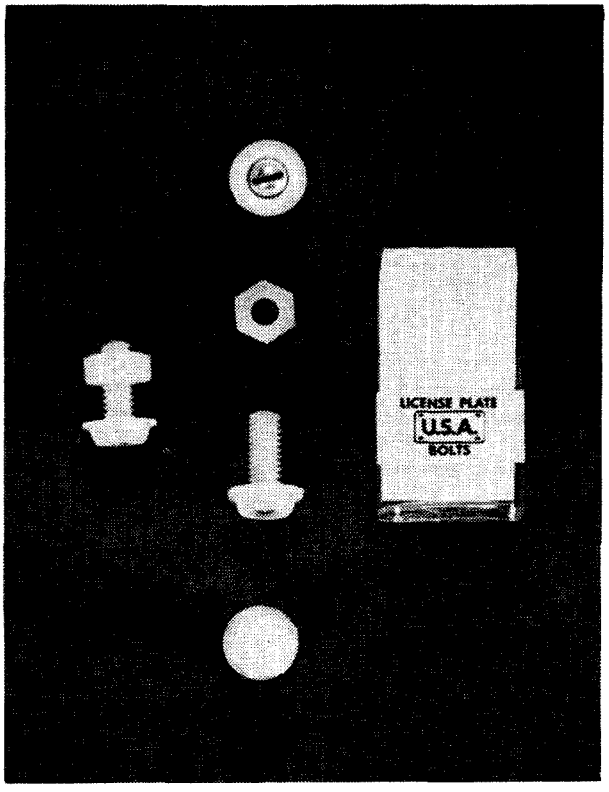
Adding one resistor is a small price for protecting your screens. Try it. . . . W9IHT

Nylon Screws for Critical Applications

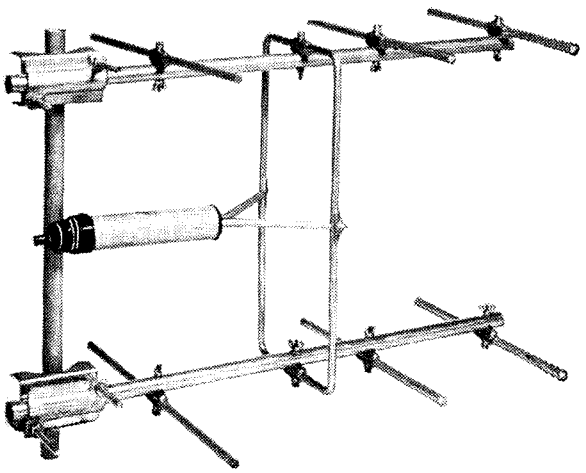
Nylon fasteners of various types have been used for critical electronic and corrosive environment applications for a number of years. However, most radio amateurs have been denied the many advantages of this hardware because of local non-availability. The screws and nuts shown in the photograph are now available through Sears and Roebuck retail stores as "Allstate" auto license plate bolts.

The screws are ⅝", ¼-20 thread, with a slotted head, metal insert. The screw style is similar to the conventional washer head type. The metal insert is molded into the screw body and only the head is exposed. The nut is molded nylon and of the conventional hex type. This low loss hardware is an ideal replacement for the usual extruded fiber washer and machine screw combination in such applications as fabrication of metal plate and film dielectric bypass capacitors and assembly of RF tank components. While the breakdown voltage rating of these fasteners has not been determined, the metal insert is centered in the screw and the low loss insulation appears good for several thousand volts. . . . Pafenberg

Photo: Morgan S. Gassman, Jr.



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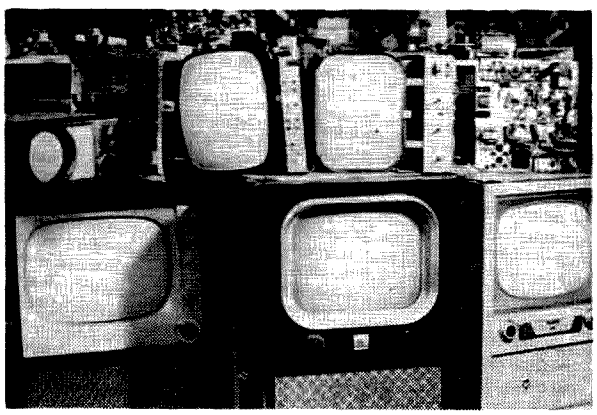
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ABSOLUTELY RIDICULOUS ! ! The time has long since passed when amateur television could be defined with statements like those given above! But why the change? What has been happening? After all, if one scans back over the past ten years of amateur publications, there is virtually no trend which would indicate a simple and economical approach to Ham TV. In fact, a few years ago if someone would have told you that you could construct a complete station for less than $50, you would have probably exclaimed, "Impossible!". The contrary is true today however, for this is not only possible, but quite practical!



Scenes like this are common in practically every appliance store throughout the country. These sets often can be obtained for practically nothing just to make room for more. This picture was snapped at Gibson Appliance, Sioux City, Iowa.

What then actually took place? Well first of all, circuits have been drastically simplified . . . they are no longer being confined to the complex and expensive techniques used by broadcasters. And secondly, but equally as important, has been the tremendous surplus of used TV receivers. These sets are presently flooding the backrooms of practically every service shop and appliance store throughout the country. So much so, in fact, that giveaway prices of $5 or less are not at all uncommon. The availability of these receivers is just what ham TV enthusiasts have been waiting for; since these sets contain approximately 90% of all the parts required to construct a complete station!

Getting Started

However, this did not appear to be the complete answer, (even though it was a tremendous boost) for TV was still not progressing in proportion to the ever mounting interests

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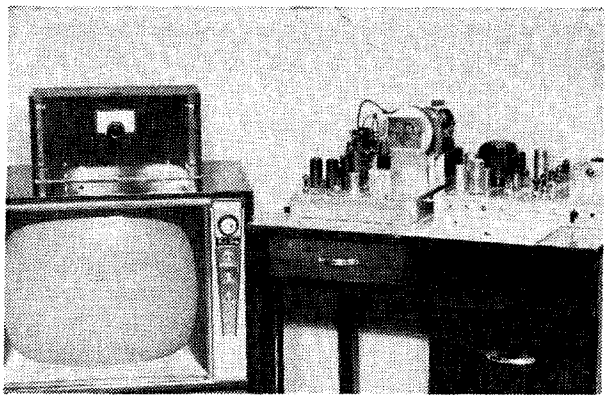
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Typical "less than $50" TV station.

shown among thousands of amateurs.

Why the continuing lag? Apparently it had to be blamed on one remaining factor . . . lack of down-to-earth literature fully covering simple and straightforward circuits and at the same time providing sufficient background theory necessary to put the entire subject of Ham Television in its proper perspective.

After some serious thought, Wayne and I came up with the following answer. We decided that in order for Ham TV to finally get off the ground once and for all, what we really needed at the present time was a complete manual fully covering the basic principles of Ham TV along with easy-to-understand circuits which could be constructed almost entirely from parts salvaged from old TV sets . . . thereby keeping the cost of the entire project below $50. Such a station is shown in the photo.

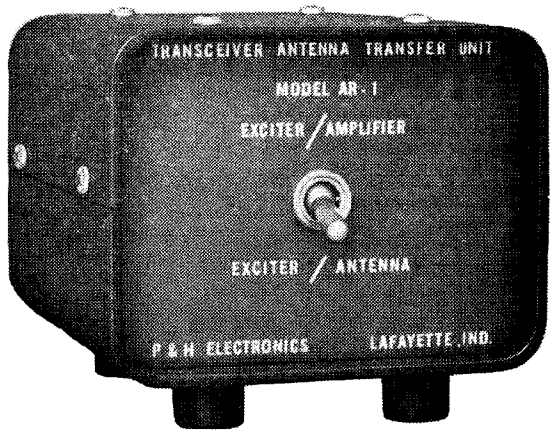
Consequently, Wayne agreed that if I wrote the book, he would publish it. So for the next ten months all available time was spent either working over the typewriter or else in the darkroom tediously processing photos and illustrations. Well, it's a little over a year later now and the project has finally been completed. Wayne informs me that the manuals have recently come back from the printers and are ready to go. Incidentally, (ahem . . . short commercial!) for those of you who are interested in obtaining this book, further details along with a handy order blank can be easily located on page 72.

The TV Station

Lets once again refer back to the photo for a closer look at the typical "less than $50"

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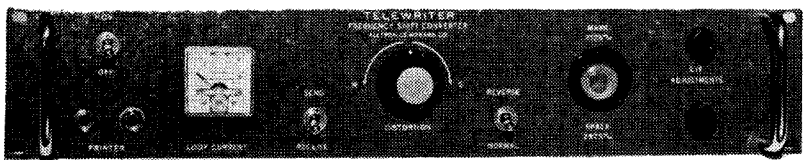
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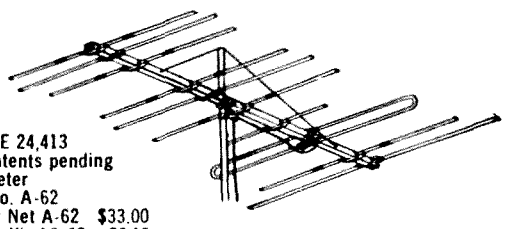


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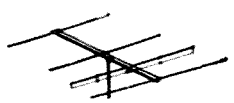
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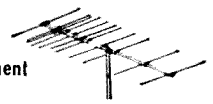
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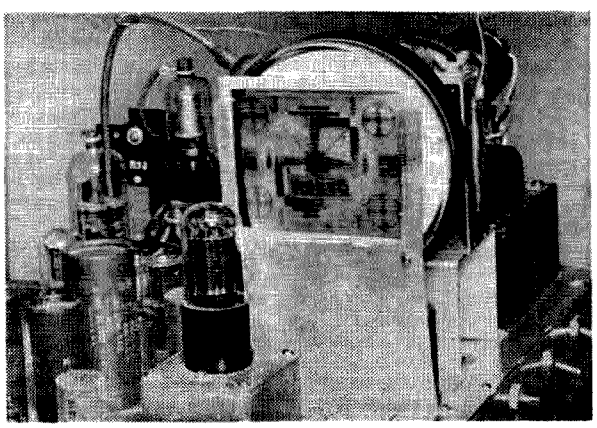
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station mentioned above. It can be divided into basically three units: (1) a receiver fed by a 420 mc converter, (2) a camera and (3) a modulator-transmitter unit. The converter is shown setting on top of a conventional TV set. Its purpose being simply to convert the 420-450 mc signal down to an unused TV channel. The camera is shown in the center and is of the flying spot scanner variety. Its output is fed directly into the modulator-transmitter unit shown at the extreme right.

The flying spot camera, for the benefit of those of you who may not be familiar with it, is essentially a slide type camera being used mainly for transmitting negatives, transparencies and line drawings. It is undoubtedly the most economical and practical approach to Ham TV.

The scanner functions in the following manner: The scanning beam of a small cathode ray picture tube is made to scan out an unmodulated raster, very similar to the raster produced on an ordinary TV set when tuned to an unused channel. Next, a slide is placed against the face of this tube so that the scanning light beam must first pass through it before being detected by a sensitive photomultiplier tube located several inches away. In this manner, the intensity of the light beam, at any one instant, will be in direct proportion to the density of the slide at that point. Consequently, we have successfully separated the picture into light variations which can be converted by the photomultiplier tube into a conventional video signal. The only thing remaining is to further process this signal, mix it with the syncblanking pulses and feed it into the modulator-transmitter unit. This method completely does away with expensive and hard-to-obtain image converter tubes, such as the vidicon and iconoscope.

The usefulness of this camera is limited only by one's ingenuity. For instance, some amateurs are mainly interested in transmitting drawings of diagrams and other sketches. In these cases, they will often choose to use a relatively large cathode ray tube (10-12



Closeup of the image converting portion of the flying spot camera.

inch) for the scanning light source and in this manner are able to very conveniently apply the drawings directly to the surface of the tube with the aid of a grease pencil. Still others like to place the light source tube in the vertical position so that games, same as checkers and chess, can be played simply by placing a transparent playing board (made of plastic) directly on the surface of the tube. These are but two of many examples in which this versatile type camera can offer unlimited possibilities in addition to simply televising "slide-type" material.

Need for Organization

Once new hope can be put back into a project, it demands continual recharging so that there will be no tendency for it to once again go stale. One very important way in which this can be done is through periodic articles (written by a variety of TV amateurs) which will keep us informed of new and different circuit ideas.

In addition to this, we need to organize (at least partially) so that we can keep in better contact with fellows who are working on projects similar to our own.

And finally, we need to determine the approximate number of 73 readers who are interested in seeing more articles on Ham TV . . . this would be a great aid in determining the demand for such articles.

As a preliminary answer to these problems, a questionnaire has been prepared and can be located at the end of this article. If everyone will take a few minutes to fill this out and paste it on a postcard we will be able to draw more concrete conclusions as to the present status (as well as the future status) of Ham TV. If a sufficient number of questionnaires are returned to indicate definite trends, the results will appear in a later issue of 73 magazine. Even if you are not interested yourself, please direct the questionnaire to the attention of your TV friends. In this manner a more complete survey can be obtained.

Additional TV Allocations

The average amplitude modulated video signal is usually considered to contain sidebands extending as far out as 4-5 mc each side of carrier; this is tremendous when contrasted to the ±3 kc sidebands of an amplitude modulated audio signal.

As a result of this large bandpass, the FCC has confined Ham TV operation to the bands of 420-450 mc and above. This is unfortunate, for before the development of satisfactory UHF receiving techniques (such as very low noise rf amplifiers) the range over which satisfactory pictures could be transmitted was quite restricted; and as a matter of fact, even

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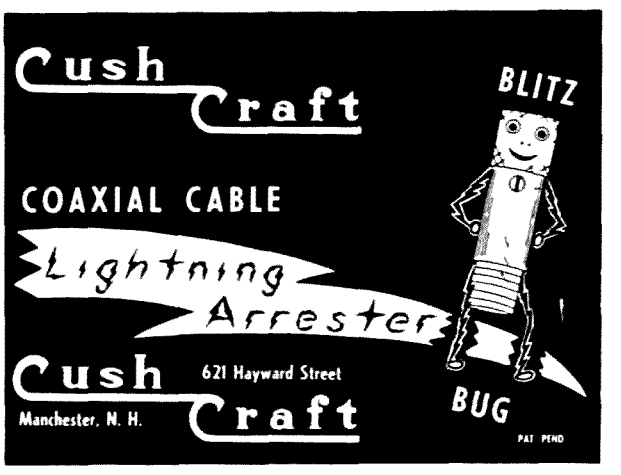
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Television picture after passing through an amplifier system whose bandpass was limited to 1 mc.

today the range is limited to essentially local and medium range work.

But do we really need this much band width in order to transmit pictures of a quality sufficient for amateur purposes? This is a common question raised by many and was also present in a recent long distance phone conversation with Wayne . . . so in order to further substantiate our feelings, extensive tests were conducted. Initially, this simply consisted of feeding a conventional video signal through an amplifier whose band-pass was limited to approximately 1 mc. This, however, immediately proved completely impractical, since the upper frequency requirements are determined almost entirely by the horizontal scanning frequency, (presently 15,750 cps, or in other words, resulting in 262.5 horizontal scanning lines) this being far too high to yield anything but a poor picture.

Previous experiments conducted by a variety of amateurs indicated that the number of horizontal lines required for our purposes could often be as low as 100 lines. Therefore, the next step consisted of lowering both the camera and the receiver horizontal scanning frequencies to a point which gave us approximately 150 scanning lines. This was a very simple modification in both the camera and receiver, requiring only the addition of a resistor in the horizontal frequency circuit of the camera and nothing more than a minor adjustment on the receiver. The results of this test immediately showed promise. The quality of such a picture is shown in the photo.

For those of you who may be interested, the required bandpass of a TV signal can be easily determined by the following formula:

$$\text{BANDPASS} = \frac{H_1^2 V\ (1.33)}{2}$$

Where H_1 is the number of horizontal scanning lines, V is the vertical scanning frequency (standard is 60 cps) and the 1.33 is the aspect ratio . . . also being standard at 4:3.

For example lets assume that we desire 100 horizontal scanning lines and the vertical frequency is to remain at 60 cps. Then the required bandpass would be:

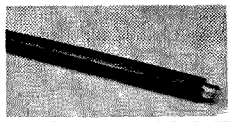
$$\text{BANDPASS} = \frac{(100)^2\ (60)\ (1.33)}{2}$$

$$= 399{,}000 \text{ cps or approximately .4 mc}$$

But exactly where does all this lead to? It would appear that these tests indicate that television signals limited to a total bandpass of 1 mc are entirely practical for amateur communication purposes. Consequently, we would like to know if there is sufficient interest among TV enthusiasts to merit petitioning the FCC for 1 mc television transmission in the upper portions of 6 and 2 meters. If operation were allowed on these frequencies, it would probably be considered the biggest single boost since the beginning of Ham TV. Long distance transmissions would finally become a reality instead of simply a dream!

One limitation to 1 mc TV transmission, however, is that normal TV receiver audio systems would no longer function since they require audio carrier to be separated from the video carrier by 4.5 mc. This however, is not usually considered serious since the larger portion of amateurs prefer to use their regu-

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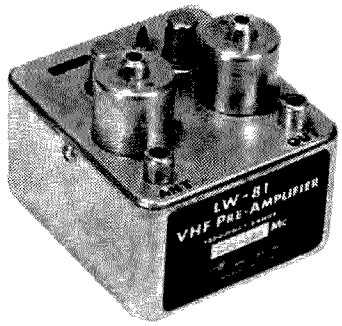
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lar radio telephone stations to handle the audio portion of the signal.

At this point, undoubtedly some of you may be wondering if this system wouldn't be in opposition to the ARRL petition for "slow-scan" TV in the 10 and 15 meter phone bands requiring a bandwidth no greater than a conventional audio signal. (Presently before the FCC.) On the contrary, our system can no more be compared to "slow-scan" TV than you could compare it to facsimile . . . for this is basically all "slow-scan" TV really amounts to; the only difference being is that it is an all electronic system in which the picture is displayed directly on a special long persistence type CR tube. This system not only requires a special picture tube, but, due to the very low scanning, also requires special deflection circuits; thereby eliminating the possibility of using conventional TV receivers.

"Slow-scan" TV also differs in another way . . . that is, it is absolutely confined to still type pictures . . . each picture requiring approximately 5-10 seconds to be transmitted. So as can be seen, the two systems are completely two different modes of communication.

This proposal would in no way be in opposition to either the "slow-scan" picture system or the present "wideband" TV system. Instead it will be a third system for transmitting pictures, using a conservative bandpass of 1 mc on bands that will make possible nationwide TV QSO's.

As in the past, the amateur bands have been designed to serve amateurs in the best possible manner. Therefore, in order to determine if there is sufficient merit to petition for this type of television transmission which would utilize the upper portions of the 6 and 2 meter bands, it is very important that the questionnaire be properly filled out and returned. This should be considered as a vote "for" or "against" the advancement of Ham Television. Please express your wishes!!

. . . WØKYQ

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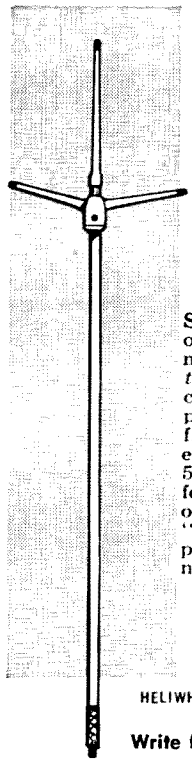
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At present many amateurs have an opportunity that may not repeat itself. I refer to the many army and navy surplus frequency meters now available, through MARS and surplus sales. Many of these meters have the original calibration chart missing, and are considered virtually useless. This is demonstrated graphically by prices, the frequency meters with charts costing $100, the meters without charts selling for one-third this amount. Meters without charts are worth more than this would seem to indicate. It is no great job to calibrate one of these meters, but it is time consuming. A little care is required, but you do not need to be a super technician or electronic engineer to do the job. Neither is elaborate equipment required.

Essential to the calibration are several items not commonly available around the shack, but easy to build. Figure 1 illustrates the first requirement. This is a 10 kc multivibrator, which will operate from a 100 kc xtal calibrator, and give 10 kc markers up to 20 mc. I am assuming here that you have or can beg, borrow, or steal a 100 kc calibrator, this being a common item. In fact, some receivers have them built in. Using this 10 kc marker source, the high band of the frequency meter can be calibrated. Interpolation to 1 kc points is then possible, and if care is used an accuracy of better than 0.005% will result.

Fig. 2 shows a simple beat detector that can be used with earphones to get an exact zero beat. It took about ten minutes to wire up a

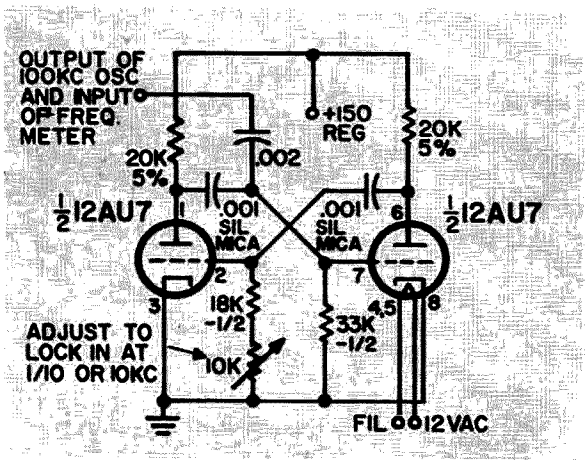


Figure 1. 10 kc multivibrator for use with 100 kc crystal oscillator, providing 10 kc beats with frequency meter.

1629 (army surplus magic eye tube) temporarily for this purpose, and it is certainly worth while in the interest of increased accuracy.

With your equipment assembled, connect the frequency meter to its power supply. Allow at least one hour for proper warm-up so that all equipment will stabilize, including the 100 kc calibrator and 10 kc multivibrator. Set the CALIBRATE control on the frequency meter to center, and be especially careful not to move it until the calibration is complete. After the warm-up period the 100 kc calibrator should be zeroed against WWV, at as high a frequency as possible. The 10 kc multivibrator

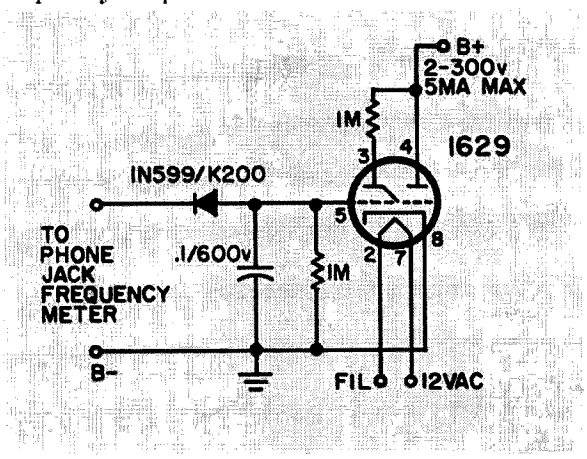


Figure 2. A simple zero-beat indicator for use in conjunction with headphones.

must be checked to see that it gives nine beats between each 100 kc beat. This can be done with your communications receiver, and it will be easiest to do it on as low a frequency as possible, say 600 to 700 kc. Now type several sheets of paper, listing the high range of your frequency meter by 10 kc points. If you are in doubt as to the range, check it with your receiver. To do this set the dial to the low end of its range, turn on the internal xtal, and zero in on the strongest beat at or near the low end. Turn off the internal xtal oscillator and find the signal from the frequency meter with your receiver. Note the frequency. Tune your receiver until you reach another harmonic from the frequency meter. The difference between the first and second readings is the frequency of the meter at the low end of its dial. Now do the same thing at the high end, and you have the primary coverage

of your frequency meter. Most have a range of 125 to 250 kc on the low band and 2 to 4 mc on the high band.

When you write up the frequency range by 10 kc points, leave a space between notations, since you will be adding information here later. Now, using the 100 kc xtal, check the high band of the frequency meter at 100 kc points, listing the dial readings. Now go back and check the dial at 10 kc points, listing all the dial readings. The checks should agree with the 100 kc checks at every tenth point. This is a handy method of cross checking yourself. You might note that on equipment of this type, always approach the final reading from below. If you pass the zero beat point, don't jockey the dial back and forth for zero beat. Go back below the beat by 5 kc or so and approach again from below. This procedure will help to eliminate error from dial backlash.

After your 10 kc points are all listed, interpolate to 1 kc points. This is the hardest part of the job, and is very time consuming. A big pot of coffee and a patient and loving XYL will be a big help here. The patient XYL can be replaced with an adding machine if you have one available, but you'll still need the coffee.

The difference between each 10 kc point must be listed. Note this in the space you left on your sheets. Each 1 kc will be 10% of this, so add 10% to the 10 kc listing for 11 kc, 10% more for 12 kc, 10% more for 13 kc, and so on. When you reach the next listed 10 kc point, the calculated listing and the measured listing must agree, another cross-check. This will take 2000 individual additions.

After the high band is finished, you may wish to calibrate the low band in the same fashion. Referring to Figure 1, change the grid-plate capacitors to 0.01 mfd. This will put the multivibrator at approximately 1 kc intervals. If you have trouble syncing the multivibrator, you may have to build another to operate at 10 kc, and sync the 1 kc from this. No trouble should be had with a strong output xtal calibrator, however. Calibrate the multivibrator as before, except with 1 kc intervals instead of 10 kc.

A calibration book can be prepared when you finish. It is a good idea to file all your original calculations and papers, should the book ever be destroyed. The frequency meter is now as good as any with original calibration book, at a good saving of money.

Sensible Attitude

Morton Burke K2ENU
8 Lockwood Place
Elberon, New Jersey

So you want to be a ham, or perhaps you already are one. It's a great hobby; really fun. But like any other interest that can take all you can give, and perhaps more, it must be approached with caution and appreciated in sensible doses. Don't get me wrong. I'm not hinting that ham radio has its faults. However, overindulgence and misdirected enthusiasm can cause enough trouble to make any avid fan lose interest. What do I mean? Well, listen to this unhappy story.

Bill Jones (I've changed the name to protect the innocent), after a year of what he thought was struggling along with only a 100 watt rig and an old receiver, decided that he wasn't going to be pushed into the QRM by those California kilowatts any longer. Since he couldn't beat them, he decided to join them. He talked his XYL into letting him put a cool 2500 bucks into what he convinced himself, and her, would be the best Ham station around. Out went the compact 100 watt rig and in went a shiny new "Voice of America" blaster. However, instead of taking up a small amount of space in his den, this new station filled the place up. The almost invisible antenna on the outside of his house was replaced by a too noticeable tower stuck in the middle of his backyard. Things were going great for Bill, but not so with his wife and the neighbors.

TVI, which was not a bothersome thing

with the 100 watter, now became a serious problem. Because the tower was so obvious, Bill was blamed for TVI even when he was off the air. To keep peace in the neighborhood, Bill restricted his activity to late evening. This didn't work out either because he had a job that required him to get up early in the morning. Soon, he found himself operating on weekends only. Within six months, Bill began to question the wisdom of his actions. And when his wife began to complain that she had sacrificed a new refrigerator, washing machine, and clothes dryer for that Ham gear that he hardly ever used, he was ready to throw the towel in. It didn't take long. Within a year after he had bought his new station, Bill was out of the ham business. He sold everything for the best price he could get; and that was that. Why did this happen? Maybe Bill should have stuck with the 100 watter.

Harry Smith, another unfortunate ham, had a different problem. He was continually redesigning his gear. As a result, his station was hardly ever in operation. He was either tinkering with the *if* stages of his receiver or "improving" the keying circuit in his transmitter. Theoretically, his approach to do-it-yourself hamming was admirable; however, he forgot that the prime purpose for being a ham is to be on the air.*

Harry Smith hasn't stopped being a ham; but the long periods of inactivity have caused him to forget the Morse Code. And when he goes on the air with voice, his contacts are always poor. Why? Well, he never settled on a decent modulator design, and his antenna coupling network is just a bit too haywire to put a sufficient amount of power into his antenna. In other words, Harry has never really had a workable station in operation; perhaps he never will.

What is it with some of us hams? What makes some of us turn away from the hobby that we worked so hard to become a part of? What causes a ham to write the kind of advertisement in the classified ham swap columns which reads, "Getting out of ham radio, will sell all my gear for $500.00, or will swap for camera equipment, or what have you?" I am not going to pretend to know the answers. I'm sure that each ham who is getting out of the "business" has his own good reasons. However, I have been able to analyze the reasons why some hams are losing interest. Most of the difficulties are caused by: lack of room in a new residence; too much money invested in seldom used ham gear; and, believe it or not, the inability to keep a workable sta-

*The author and the Editor are in disagreement here. Hon. Editor believes that the experimenter is doing far more to earn his keep than the rag chewer and that the continued availability of frequencies for hamming will in the final analysis be dependent upon the technical advances that hams develop.

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tion on the air.

Instead of discussing the above points in detail, for the sake of brevity, I would rather outline what I think is a sensible approach to the whole situation. First, get a small inexpensive CW or phone station on the air as soon as you can. After this is done don't make any extensive modifications to it. Any increase in power or mode of transmission should be done by building or buying additional gear. By doing this you will have a rig available which will work at any time. Second, don't go wild with extra gear purchases unless you're sure you can afford it. Third, put yourself on an operating schedule that will not conflict with your family's interests.

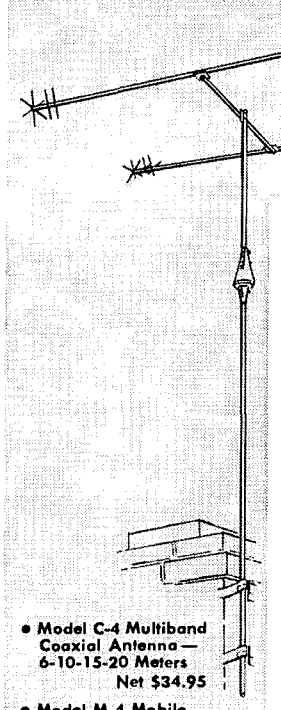
I've hinted at this small inexpensive workable station throughout this article. I can't overemphasize this point. For those hams who live in relatively cramped city quarters who like phone, get yourself a 2 meter rig. This set-up is inexpensive and activity is plentiful on a local basis. I prefer 40 meters for CW. I have a folded dipole antenna snaked about my attic that my neighbors can't see. My DX-35 and an old Hallicrafters Sky Buddy receiver with a Heath Q-multiplier complete my ever working station that never gets modified. TVI suppression is easy when you can concentrate on one band with relatively low power. I admit that I get very few super DX QSO's with this set-up, but I can get on the air in minutes confident that I'll make some fine contacts. I never have that guilty feeling that perhaps I've got too much dough tied up I can really relax and enjoy my hobby.

Getting on the air regularly is important if one is to maintain interest in ham radio. However, overindulgence, as in other things, can get you in trouble. What wife wants to be a ham widow? The important thing is to get on the air at least twice a week; and make at least one of these contacts on CW. I know some phone enthusiasts who have completely lost their "fists." I have heard some of them say, "I used to send and receive at 25 wpm, but I've spent so much time gabbing away that I can't copy code anymore."

Don't let this happen to you. Most of us have worked too hard to reach the required 13 wpm for our General license. It's a shame to let it all go down the drain.

For most of us ham radio is a hobby. And by definition a hobby is supposed to be a happy, enjoyable pursuit. And when our hobby ceases to be a pleasurable source of relaxation, we lose interest. You can prevent this loss of interest by always having a workable rig on hand; by not going too deeply in "hock" when you expand your station; and by following a reasonable operating schedule that doesn't foul up your home life. What I'm trying to say is, adopt a sensible attitude toward ham radio. . . . K2ENU

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(W2NSD from page 4)

Which Brings

Me to where I left off last month on page 75. . .the International Porsche-Treffen at Locarno Switzerland. Shortly after whipping over the San Bernardino Pass I found myself in Locarno. A little hunting uncovered my hotel where reservations had been made by the Porsche Club of America. Locarno is a small resort town overlooking Lake Maggiore and about ten miles from the Italian border. The one hundred cars of the PCA assembled the next morning in Lugano, a couple of miles away, and drove with banners flying in a convoy to the Treffen meeting.

There were reported to be over 1000 Porsches at the meeting! We counted over 800 on the huge field where we parked for the free lunch put on by Knorr (soup manufacturers). There were large contingents from the various Porsche clubs throughout Europe. I know of nothing else like this in the world. The license plates were from Norway, Sweden, Finland, England, Ireland, Belgium, Netherlands, Luxembourg, France, Germany, Austria, Italy, Spain, Switzerland, Monaco, Portugal, Denmark, and the U.S.A.

The events went on for two days, including a hill climb and a gymkhana. The Porsche factory rented three large sightseeing boats, loaded them with food, wine and bands, and we were all off for a cruise of the lake down into Italy and back. The final event was an ox-roast with about six oxen being roasted and several truckloads of wine to help wash it down. It was a wonderful affair.

One of the lads managed to spin his Porsche off the road and roll it over a few times. He wasn't hurt, but the car was a mess. I went right down to the garage and took a couple Polaroid shots to send back to K2QWO, just to worry him a bit about his car. I noted on the photos: "Ooops!!"

Locarno was so close to Varese Italy that it was only natural to buzz on down and stop in to see I1LOV. Somehow I managed to get talked into staying overnight there and operating his rig. Rig? No, rigs is closer. He had one each of everything made. His shack looked more like one of those setups at a worlds fair where they have room for ten people to operate simultaneously. I could describe Augusto's house, but you wouldn't believe it. Palatial.

The next day I drove back up into Switzerland and landed in Geneva by nightfall. George Jacobs W3ASK had made reservations at a nice inexpensive hotel right in the heart of things for me. George filled me in on what had happened so far. I signed in the next morning and got my credentials as an official member of the U.S. Delegation, which included a stack of papers about two feet high. This pile sorted down to a small handful that were concerned with the amateur allocations.

The decision by the Russians, at the opening of the Conference, to back up the U.S. position of making no changes in the short wave frequency allocations at this particular conference and holding all problems of allocations for a future conference a few years hence, had reduced the matters pertinent to ham radio to a few very minor points to be clarified. The Conference dragged on for over three months, but much of it was more vacation than work.

When the time came about three weeks later for me to return to Stuttgart for the return flight of the P.C.A., it was obvious that there really was nothing to be gained by staying around in Geneva. On the return I stopped at Mt. Blanc and made the trip up the tramway. It is awe inspiring to be dangling over several thousand feet of nothing like that. Don't miss this trip if you can help it. They don't believe in safety precautions like we do and there were only rough boards thrown over some scaffolding to walk around the top of the mountain, with lots of room to fall. No one fell though.

Once back in Stuttgart we turned our cars over to the Porsche factory with instructions for any modifications, accessories or repairs, boarded a bus and were soon on our way back to the U.S.

The trip made such an impression on me that I have been dreaming of making it again. Now that I'm married I'd like to show Virginia what Europe is like and what all the hams over there are like. We've signed up for the 1962 Porsche Treffen which will fly to Stuttgart on April 1 and come back on the 28th. The money for all this folly was donated by my Grandmother as a wedding gift. It had to come from somewhere outside for 73 still can't pay me a salary. Instead of buying one of those nice new 1962 Porsches we will ship my 1958 model over and have it waiting for us with a repaint job and some upholstering by the factory.

I'd like to meet club groups in as many cities as possible. Maybe you can put me in touch with fellows to contact along the way. The itinerary runs about as follows: Stuttgart (DJ1BZ), Heidelberg, Darmstadt, Weisbaden. Frankfort, Berlin, Hanover, Rotterdam, Amsterdam, Brussles, Paris, Geneva, Berne, Luzern, Zurich, Liechtenstein, Locarno, Varese, Milano, Genova, Fierenze, Venice, Trieste, Zagreb, Wein, Linz, Munchen, Stuttgart. Ambitious for four weeks, but that is all the time we have and we want to visit as many places as we can.

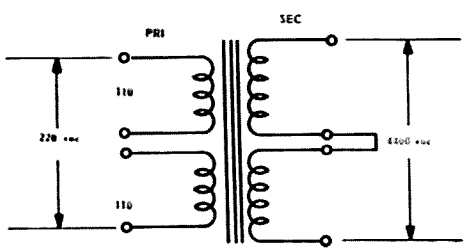
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THE beast we are to consider here has a squat bulky appearance, stubby high voltage snouts, and weighs in like a razorback. Case, oil, and all it runs around one hundred pounds. Contact with this animal when it is excited is not recommended. This is the venerable pole pig transformer used by power companies.

Knowledgable amateurs have been using pole transformers for years in high voltage supplies, but there has been a lack of information which dealt with these cheap sources of B plus thoroughly. In this day of hypersil cores, improved steels, and general miniaturization of transformers, there are those who would assert that the pole pig is obsolete. Maybe so, but it still provides an economical way to high power.

There are two ways to obtain these transformers. Since few power companies are installing new pole transformers with less than a ten k.v.a. rating, the 1½, 3, and 5 k.v.a. models are obsolescent and are gradually being replaced. Method one is to have a friend in the power company who can watch for one of these transformers when they are being replaced. If you can't scrounge one this way, the second method is to meet them at the junk yard. The pigs are seldom shuttled off for use elsewhere, more often they are sold to junkies who burn them to free the laminations from the valuable copper. The latter method has been the most fruitful one used in these woods. Consider that there are several hundred old transformers at the local junk emporium



—most of them bad. How to tell a good pig from a bad one?

You are presented with a morass of transformers, some good, some burned out, and of several different ratings. The ratings are marked on the cases: 1½, 3, 5, 10, etc. k.v.a. The 1½ k.v.a. models are rarely found with high voltage center taps, ordinarily they put out 2200 v.a.c. from leg to leg. Even if you used one of these models by bridge rectifying, the regulation would be poor. If you can find only 1½ k.v.a. models, get two, and run the secondaries in series for 2200-0-2200 v.a.c. The 3 or 5 k.a.v. sizes are the ones to look for. They provide a neat, one package, way to go. Pigs larger than 5 k.v.a. have high exciting currents and are difficult to turn on. Besides, they are unnecessarily bulky. Disregard any "bad" markings on the cases, they are frequently misleading. It is a good idea to add your own marking so that when you come back to get another pig, you will not duplicate earlier efforts.

To select a good pig you are going to call into use all your senses. Open the top cover and look in. In a good unit the oil should be reasonably clear. There should not be evidence that the oil has boiled away leaving a charred residue. There will be a rancid, burned out smell and the core will be blackened in a bad pig. The visual definition of good or bad is usually quite clear.

Assuming that you have found a transformer which merits further investigation, look to the electrical characteristics. The high voltage side is supported in ceramic and the low voltage side has leads running directly to feedthrough terminals from the core. Also, the low voltage leads appear to have high current carrying ability. If there are four terminals on the high voltage side, you have a pig that is 4400 volts center-tapped, or 2200-0-2200 vac. The center tap is made by joining the two center terminals. If there is no center tap, only two terminals on the secondary, you would have to bridge rectify the transformer to use it. If the unit is one you can use, begin checking with your trusty VOM which you have brought. There should be no shorts from primary to case, secondary to case, or between windings. The primary should be continuous and show very low resistance. The secondary resistance reading should show the effect of Lenz's Law for inductance, the VOM reading will ooze on due to the high inductance present. The reading should finally rest at 50 to 70 ohms. There is enough inductive energy storage here to see a good sized spark upon discharge. If the pig passes these tests, you are ready to pay for it and take it home. Leave the case and oil behind if you don't want to carry them, they are unnecessary. Contrary to the belief held by some, the oil plays no part in the insulation of the transformer, it is coolant only. At the ratings you

will be running the pig, you will not miss the oil. In several years of supplying a kw with associated bleeders and modulator, I have never even taken the chill off the iron in the beast. With its low secondary impedance, this transformer makes an excellent high voltage source. You will probably pay $2 to $3 per K.V.A., and since the junkies are interested in the copper only, they usually allow the return of any transformers which turn out bad at home. In several years of pig picking, the author has had a hand in locating approximately a dozen transformers. Only one was found to be bad after it was taken from the yard, and this was when one of the aforementioned rules was ignored.

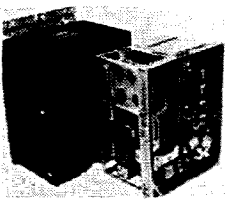
Both primary and secondary are split into two separate windings. The low voltage side, or "primary" as we use it here, should be paralleled for 110 vac operation or seriesed for 220 vac operation. Both connections can give the full secondary voltage, but the 110 volt connection is not advised for high power work. The doubled line current in 110 operation as against 220 operation does not help the regulation of the supply. Proper high power practice dictates the use of 220 volt input. Needless to say, you cannot put 220 volts on the 110 connection for twice the secondary voltage. This would over-excite the primary, and certainly burn up the transformer. Also, the phasing of the input leads must be proper. If the phasing is out, there will be zero voltage developed in the secondary. A safe way to check phasing is to excite the primary with a low value of ac such as could be gotten from a filament transformer. Then check to see if there is voltage in the secondary; if not, reverse the primary leads, and the voltage should appear. Remember this connection for when you install the full line voltage. Remember always that the device you are working with is lethal! You do not have a second chance.

With 220 volt input, a full wave rectifier, and a normal, low resistance filter, the output voltage should be just under 2100 vdc from a supply using a pole pig. A variac running on the 15% over setting will increase the output to almost 2400 vdc. These transformers can be used in many ways. Put 110 vac on the 220 vac connection and use the 1000 volts so derived for the exciter supply. Research here shows that the secondary could even be used as a swinging choke, the value ranging from 9 hy to 3 hy over the current range from .1 amp to 1 amp. One user has gone so far as to employ two pigs back to back to form a kw modulation transformer. The purists may scream, but only one person in ten could tell that the audio system had been changed from a standard modulation transformer, and his comment was that the low frequency response appeared to be better than it had been!

. . . K2LZF

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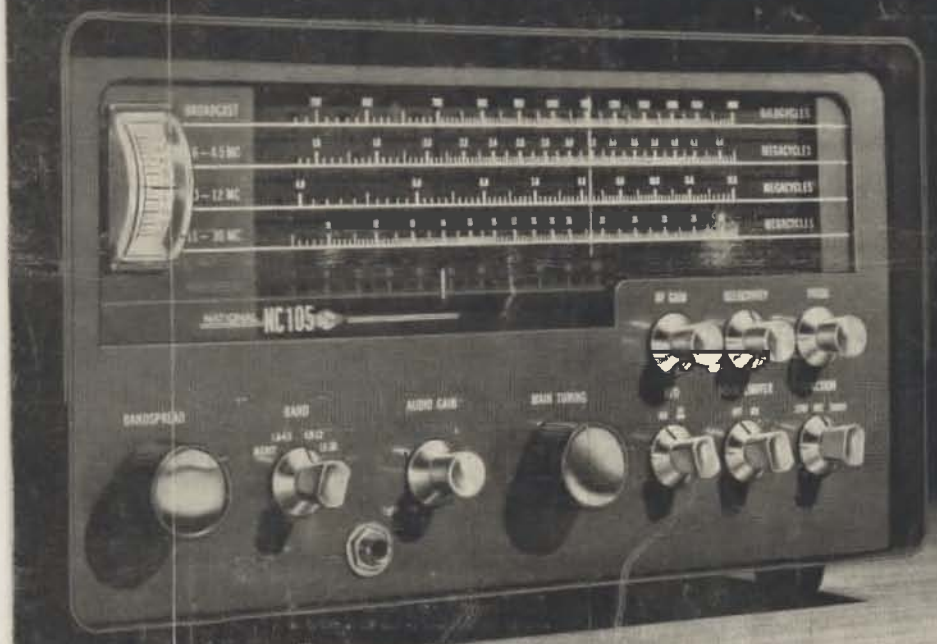
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RTTY



73 Magazine

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. . . de W2NSD

. . . never say die

That New-Tronics contest sure cut into my time this month. I've been mulling over all sorts of names for that new mobile antenna system of theirs. With me it is the fun of the chase, not the prize, for I have no doubt that down somewhere in the fine print I'll find that editors of magazines with two or three numbers or letters in their titles are not eligible. Since I'm the hopeless victim of a love affair with a six volt car that KWM-2 they're giving away (with all the trappings) wouldn't really be useful and would only bring on melancholia.

N-T is ready to lavish all this joy on whoever dredges up a name for their new mobile antenna system. It is just as well that I don't have a say in this thing, for the names that come to my mind would probably set up shock waves out in Cleveland. I'm just not serious enough. Gems like "Old Foldie," or "The Folding Rover" or even "The Roving Folder" scare away more reasonable suggestions.

Maybe I'm giving something away, but it has been my experience that very few fellows really makes a serious effort to win contests like this and there is a good possibility that you might drive off with the cornucopia if you beat out that March first deadline.

Interference With Basic Rights

San Mateo (California) has gone too far. I sure hope that someone will start the ball rolling out there for a showdown. On October 19th, 1961 a new zoning code classified ham radio as a "special use" which required the review and authorization by the San Mateo Planning Commission before a new amateur station could be installed. This did not apply to presently established stations unless there was to be some change in the transmitting antenna. A letter from the Director of Planning says, "The objective is to provide more adequate protection to life and property in the location and erection of antenna, and to regulate the operation of the amateur station for the convenience of all concerned." The last part is what this is all about . . . the regulation of the operation of the amateur station. Unless I am all at sea legally (and I don't think I am), they can be stopped in this interference with interstate communications. This is a federal rap fellows, and many communities that have tried to meddle with us have pulled back broken stumps. I'll bet that Maurice Hindin W6EUV could put a stop to it if you let him know. I understand from Brat W6OWP that it costs you $50 to get a permit to erect a new antenna, and this is after a hearing at which all neighbors who live within 500 feet may be heard. I'll bet that darned few new hams move into a place like that!

Nickel Nurser

What a bunch of pinchpennies we are! I just stopped to think it over and was amazed at the comparison of ham radio with other hobbies and interests. While it may be cheaper to collect used matchbook covers, you would be hard put to work up much of a list of hobbies that take less investment or maintenance.

How many hams spend as much on their station as a boating enthusiast? Precious few, that's how many. There are some 400,000 boaters floating around the country and they pay an average of about $3500 for their boat, watch it depreciate at about $500 a year and then spend about $800 a year on upkeep, accessories, mooring, yacht clubs, gas, and insurance. Just imagine the ham station you could have if you spent like this on it! And you wouldn't have to use it only half of the year as most boatmen do.

How about the 100,000 pilots around the country? What kind of hamshack would you sport if you invested $7500 in the original equipment and added about $1500 a year to it. New planes average around $7500 and yearly expenses for overhauls, new carburetors, patching damage, fixing broken struts, new tires, tie-down fees, accessories, charts, instruction, etc., all played as a counterpoint to the melodic tune from the aviation gas pump rack up an easy $1500. Flying is an exciting hobby . . . one where you can easily kill yourself (the leading magazine devotes space each month to detailed accounts of how pilots managed to kill themselves and their passengers during the previous month). If you think hamming is dangerous just ask your insurance broker and find out what happens to the rates when he learns that you are taking up flying. And you can ham when it is raining, fogging, snowing or just plain windy.

You want me to name more? Well you have to figure on about a minimum of $800 a year in upkeep for a horse unless you have a farm. The horse can cost from $200 for an old used one to $2000 for a new model, a lot like a car. How about a car? We're talking hobbies so let's consider a sports car: $3000 to $5000 down and several hundred a year on upkeep and depreciation.

Maybe we should consider investing a little more in our hobby of ham radio. Like any

other hobby, the better the equipment you have the more fun you get out of it. Sure, you can get a kick out of working 5000 miles with a transistor rig, but suppose this is all you had? How many days before you got tired? We aren't allowed very many days on this earth and those few that we do have seem to slip by mighty fast. Suppose you had bought that big rig you were thinking about last year. By now you'd have a bunch of friends all through Europe that you talk to every few days. You might even have your DXCC by now. How about that mobile setup? Look at all the fun you've missed by putting off getting that new rig!

Ham equipment prices are really very reasonable. Compare what it costs to have one of the finest ham shacks in the world with what it costs to have one of the finest horses, the finest sports cars, or the finest plane. No comparison. For that matter you can put out a signal every bit as potent as anyone else in this world for less than most people are spending for their cars, boats, etc. And you can buy the equipment on time just like they buy their cars and boats.

Now, check book in hand, let's read those ads.

Europe

As the April first date of our flight to Europe gets closer I find myself thinking more and more about the trip. I think of little things, like how can we afford it? . . . how will the magazine do with me away for a month? Lord, if I can't keep up with it while I'm here working every minute, what is going to happen with me away for a month? Aaagh!

Virginia and I have been working at 73 for two years now and I guess we're not out of line to relax for a month and visit ham clubs and hams all through Europe. By the way, if you have anyone we should look up over there drop me a line and we'll try to put 'em on the list.

Of Porsche

I was a bit vague last month in the editorial and some question has been raised among the few stalwarts who brave their way through this morass about my Porsche. Complete explanation: Back in late 1957 I became increasingly aware of sports cars and decided that this was for me. Consultation with Sam Harris W1FZJ and Ken Grayson W2HDM made it obvious that the finest car I could buy would be a Porsche. Byron Kretzman W2JTP put me in touch with Dave Brown K2IGY, a Porsche owner, who in turn located a new Porsche for me. This was a silver 1958 Porsche Speedster. They were right, the car was fabulous. In the late fall of '58 I got a chance to make my first trip to Europe, as previously described, so I ordered a '59 Porsche (red) and picked it up at the factory. Following my usual pattern of holding on to things I kept the '58 Speedster. The new model was much nicer: roll up windows, big comfortable seats, etc. But after driving it for a few thousand miles I began to like the old car better with its bucket seats and lower outline. The new one, used very little, was the one that I finally had to sell in order to put 73 on the newsstands. K2GZO is now the proud owner.

While it would be nice to order one of the brand new 1962 model Porsches on our flight in April, our problem has been one of having enough to eat, not what car to buy. We've just shipped the '58 Speedster via Stu Danoff K2RBM back to the factory for some up-fixing. We'll drive this around and then ship it back later. This seems to be the most practical for a pauper tour of Europe.

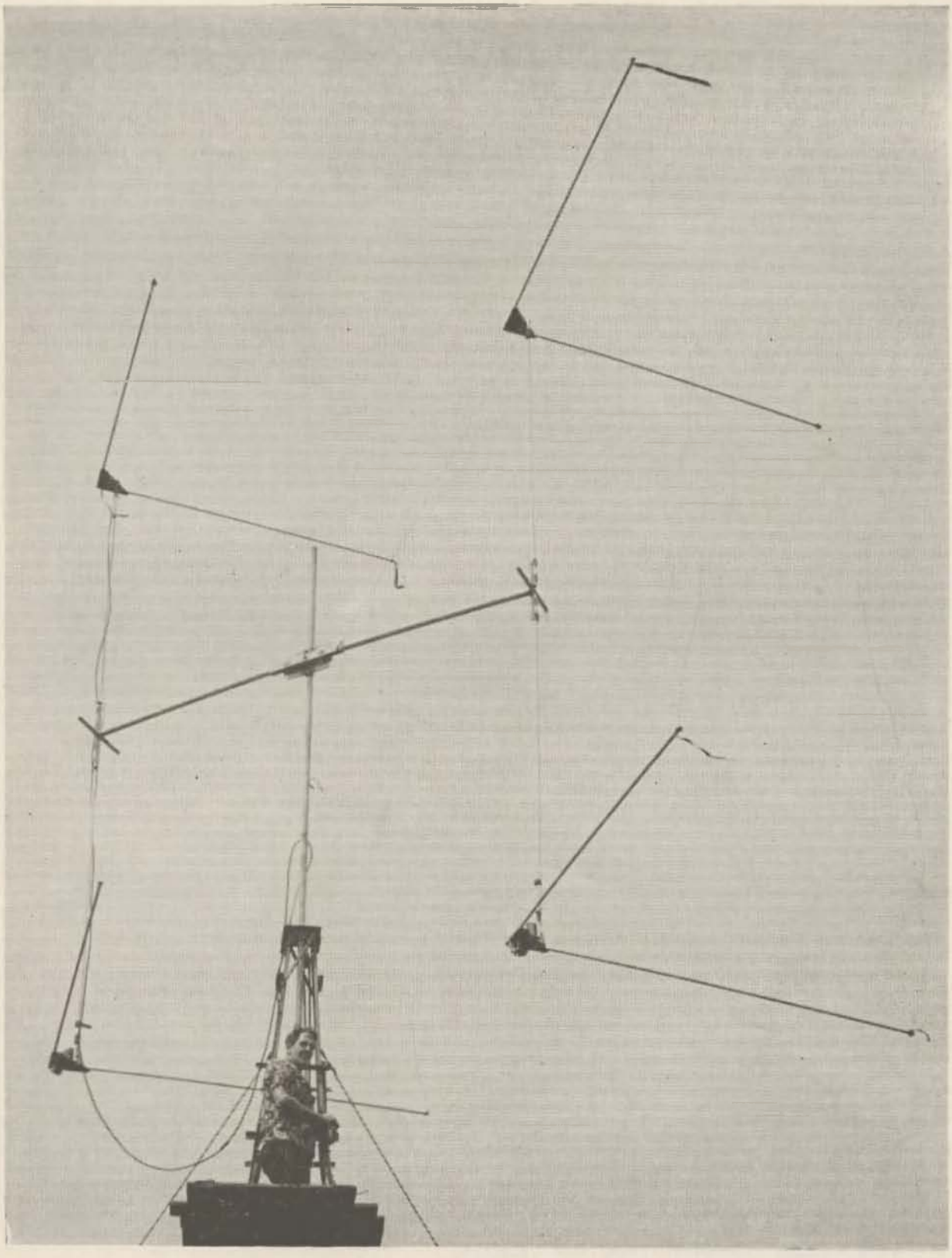
Disneyland

A letter from Ted Glick K6LJA, the General Chairman of the 1962 Southwestern Division ARRL Convention, points out that most of the suggestions that I made about conventions paralleled the plans of the convention committee. The General Registration fee is $1.50, etc., etc. It sure sounds like they're going to have a fine show for us on June 1-2-3. Virginia and I will be there. This is Virginia's first trip to California so try to keep the smog down, eh?

Central Electronics

It was with great disappointment that I learned the other day that Zenith has decided not to continue producing the Central Electronics line of equipment. The decision apparently was made on the basis that the amateur market had not turned out to be as large as they had hoped it would be. I'll bet that we'll be hearing a lot more from Wes W9DYV as soon as he can get things organized for a fresh start. It's too bad that there isn't some profitable way for a chap like Wes, who is probably one of the best engineers we'll ever see, to design equipment and not have to spend most of his time with production, procurement, testing, sales managing, advertising, expediting orders, going to conventions, and the hundred other hats that he has had to wear. There are several fellows around the country that would serve us all best if we could provide them with a comfortable living, keep them supplied with parts and just let them build ham gear. Maybe someday, when 73 can get out of its own way, we can set up something like that. Imagine what would come out of a group like Wes, Sam Harris W1FZJ (winner of the coveted ARRL Amateur of the Year award for 1961), Bill Ashby K2TKN, and Frank Jones W6AJF. I'll bet they could outstrip any research lab in the country.

(Turn to page 77)



The V-Loop Beam

Angel Fernandez W2NQS
2017 Homecrest Avenue
Brooklyn 29, New York

FOR the past year I have been experimenting with various types of closed-loop beams, doing my work up on 420 mc where a half wavelength is only 14" long. This is the answer for fellows like myself who have to work things out by trial and error rather than with a text-book and computer. The method works, as you will see.

And what did all this come to? A lot of decibels which we can all use to advantage.

The V-Loop dipole (Fig. 1) provides almost 1.5 db of gain due to the directivity provided by the upper and lower sections operating in phase. A 90° angle results in the two V wires forming a bi-directional beam, just as you would with a longer legged V-beam. By adding a second V-Loop spaced 0.15 wavelength away as a parasitic reflector (Fig. 2) we add 8.5 db for a total of 10 db forward gain. The front-to-back ratio measured better than 36 db! I was unable to measure the front-to-side ratio, it being greater than my equipment could handle.

Once worked out empirically on 420 mc, it was only logical to reproduce the beam in the twenty meter size and see what the results would be. Each leg is ⅛th wavelength long and the V's are ¼ wave apart vertically. A stub and tuning condenser was placed in each of the lower V's to provide fine tuning of the beam. See Fig. 3!

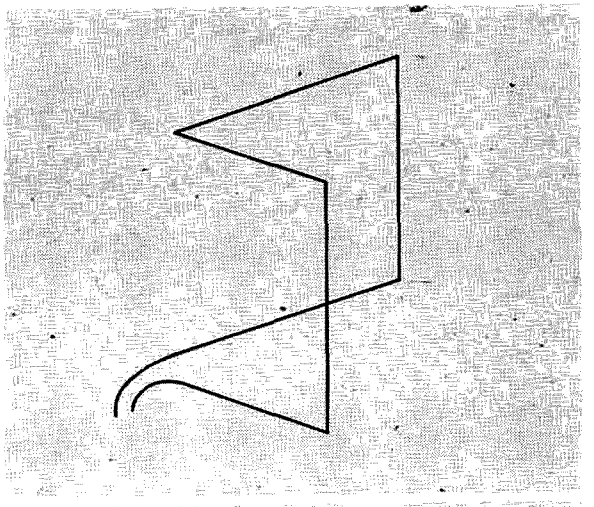
Construction

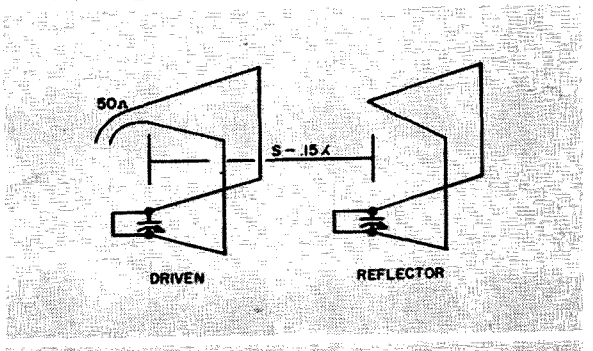
The main items you have to make are the four supports for the V's. Cut four pieces of plywood per Figs. 4 & 5 and apply a heavy coating of fiber glass resin, which you can get at any boat supply store, and let it dry overnight. Join the two V-shaped pieces of plywood, as shown in Fig. 6, using a 1" x 1" x ⅛" aluminum angle strap. Then follow through as in Fig. 7.

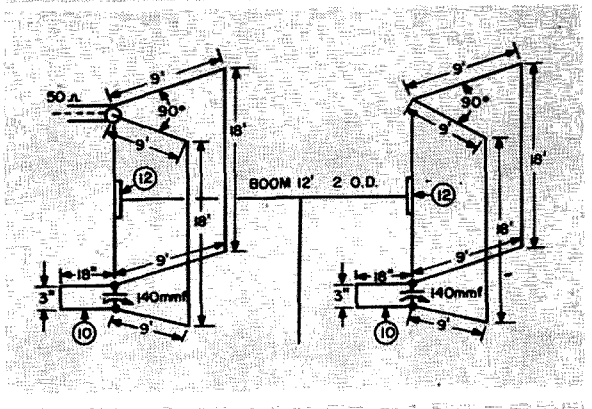
Tuning the Array

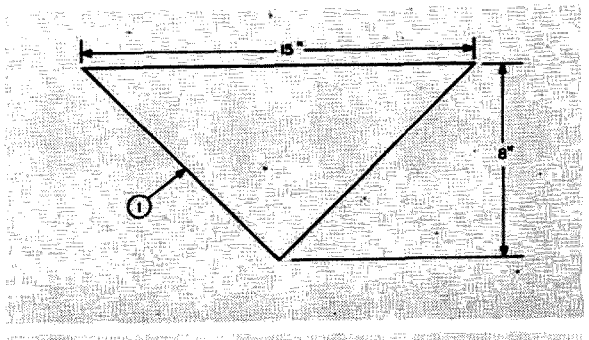
You should now mount the (V) beam at least 30 feet in the air as measured from the bottom of the beam for best results. Bend both hairpins to form a half circle and tape the shorted end with Scotch electrical tape and secure to the vertical boom. Connect a half wavelength of RG-8U cable to the top segment of the driven element and tape the cable at several points all the way down the vertical boom. At the other end of the cable connect an S.W.R reflector meter and tune the variable condenser for a minimum S.W.R meter reading at any frequency desired.

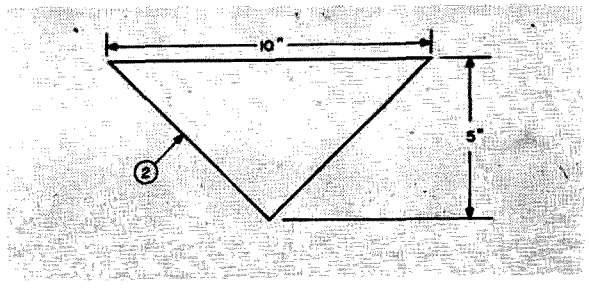
The assistance of a nearby amateur is now required to supply a steady signal for adjustment purpose. The back of the array is now aimed at the signal source. Receiver gain is adjusted to produce an (S) meter reading of (S-9). The variable condenser at the bottom segment of the reflector should now be tuned for minimum signal. Now go back once more

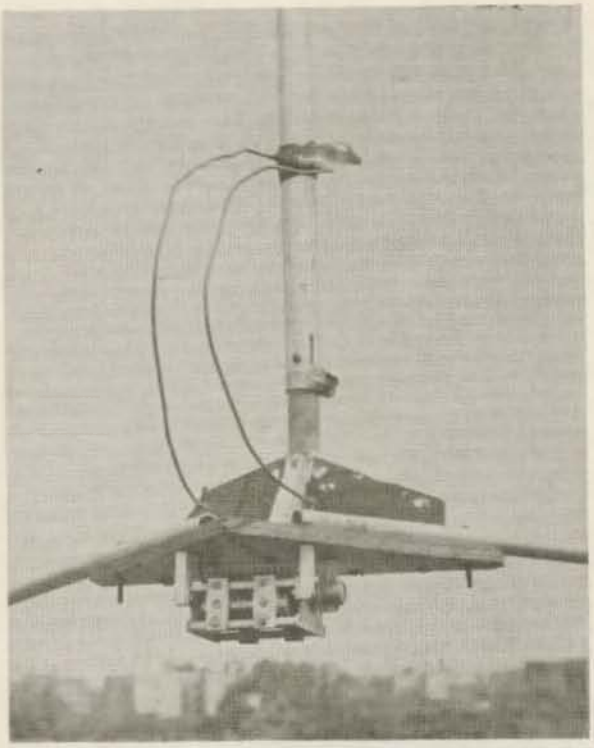


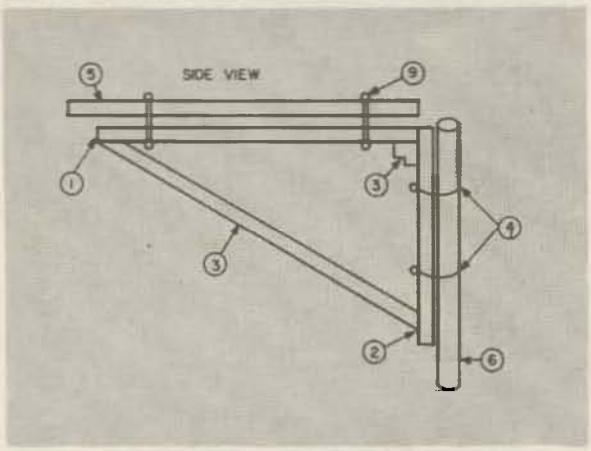


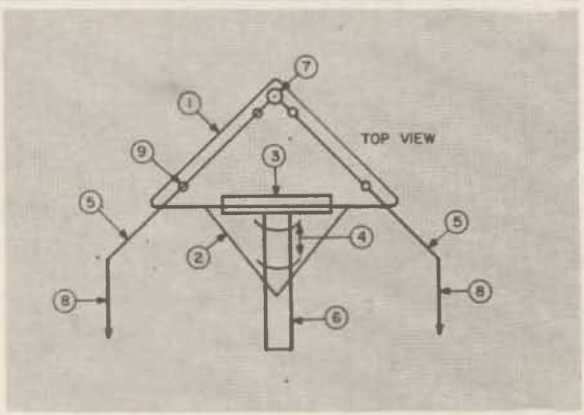












to the driven element and tune again for lower S.W.R meter reading.

On the Air Test

While running 50 watts input and the beam but only 14 feet from electrical ground I was able to override K2JSO who was running 500 watts to a 50' high 3 element beam and K2DNX who was running 150 watts to a 65' high Quad, while working W4JGR in Miami, Fla.

All in all, the antenna has been a delight to have around. In fact, when I don't get them on the first call I go down the basement to see if the transmitter has blown a fuse or something.

. . . W2NQS

Part List

1—Four pieces of 15"x8"x½" Plywood
2—Four pieces of 10"x8"x½" Plywood
3—Four pieces of 10"x1"x1" ¼" Alum. Angle
4—Eight pieces of 1"x½" U-Bolts
5—Eight pieces of 9' ⅝" D. .049 Wall Alum. Tubing
6—Four pieces of 9' 1⅛" D. .058 Wall Alum. Tubing
7—Co-Ax fitting
8—18' each of No. 8 Alum. Ground wire
9—16 pieces of 10/32 Brass screws and nuts
10—Hairpin 18" long and 3" wide—No. 8 copper wire
11—2-required 140 mmfd variable condenser in water-tight box
12—2 Cesco Quad arms
Match all circle numbers as per (Figs. 4-5-6-7)

A Simple RTTY Interconnections Unit

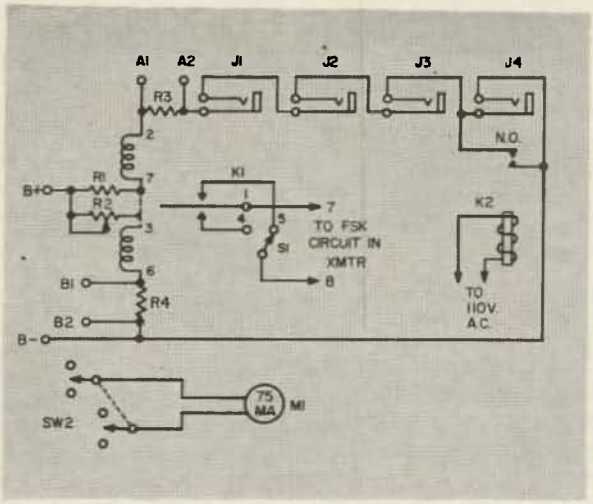
Gordon E. Hopper W1MEG

AS a newcomer to RTTY operation, one of the first problems encountered is the necessity of providing a dc loop circuit and a method of tying the various RTTY units together. The newcomer, naturally, will possess a printer, a receiving converter and his communications receiver.

There are many ways of interconnecting these units into a workable system and this article will describe the simplest way of accomplishing the job. As you progress further into the art, you no doubt, will outgrow this unit, but the primary purpose of this article is to get the newcomer started as easy as possible.

The writer, as is the case of other Army MARS members, uses a Model TG-7B (15) printer, a TG-11 perforator, a Transmitter-Distributor and an audio-type converter.

A 110 v dc power supply is needed to supply power for the printer magnets and an inter-



connections unit is necessary to allow the transmit/receive switching, to key the F.S.K. VFO unit and to allow easy connection and disconnection of auxiliary equipment.

The schematic shows an interconnections unit which accomplishes these functions.

If your audio type converter has its own polar relay, the output of the converter plugs into J4. This will key the 60 ma. dc loop and any other units plugged into the other jacks.

Incidentally, these jacks are of the closed-circuit type and are insulated from the chassis.

K1, the polar relay, is used to frequency shift key a Viking 2 VFO keyer. SW 1 is used to provide "mark high" or "mark low" without retuning the receiver. K2, a SPST, 110 v ac relay, is used to short out the converter during the transmission period. Voltage for this relay coil is obtained from the rear of the Viking 2. R3 and R4 are metering shunts. Control R2 is used to set the loop current as operating conditions determine change to maintain the necessary 60 ma. The red connector (selector magnets) plugs into J1, the black connector (keyboard) plugs into J2. These are the two lines from the printer. The Transmitter-Distributor plugs into J3.

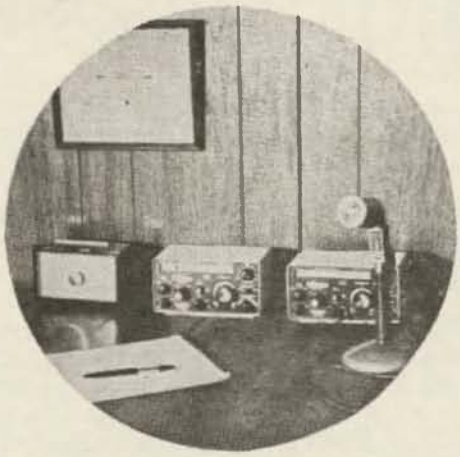
The entire unit is built on a 8x6x4 inch chassis. The power supply used is a surplus RA-87 unit, but any good dc supply capable of delivering 100 ma. will suffice.

If you have difficulty locating the polar relay they should be available from Feliciano I. Esteban, W2ZKV, 84/24 57th Ave., Elmhurst 73, N.Y.; Tom Howard, W1AFN, Box 19, Boston 1, Mass.; or from Radio Bookshop (p. 60).

Parts List

K1—W.E. 215-A or 255-A Polar Relay with socket.
K2—SPST 110v. ac NO Relay.
J1, J2, J3 and J4—Closed circuit. insulated phone jacks.
SW1—SPDT toggle switch.
SW2—DPDT toggle switch.
M1—75 mils.
R1—2,000 ohms, 10 watts.
R2—5,000 ohm potentiometer, 25 watts.
R3 and R4—20 ohms, 1 watt.

MOBILE SSB - TRANSISTORIZED!



The davco receiver, SSB Exciter-transmitter and linear amplifier bring the cost of a complete deluxe 120 W installation to less than $700! You'll find the details on the receiver in the January 73 on page 6. We'll have more information for you on the transmitter in the March 73.

The demand, as you might expect, has been incredible. We are doing the best we can to fill the cash orders that have been placed directly with us. These will be filled in the order received. We're building and rigorously testing these units as fast as we can, so please bear with us and our growing pains.

In the meanwhile, if you'd like to read more about these units, please write for the specifications.

Dial (Area Code 704) 253-8340

davco *electronics company*

113 Norwood Avenue · **Asheville, North Carolina**

Final Tanks

Paul Barton W6JAT
Jennings Radio
P.O. Box 1278
San Jose 8, California

HAVING the proper L/C ratio or "Q" in an rf amplifier is important for best operation. The proper Q is necessarily a compromise, depending on the type of operation. For Class C operation the Q must be relatively high to attenuate harmonics. But the higher Q, due to higher circulating currents, has higher losses. For Class B operation (linear amplifiers) the harmonic attenuation factor is unnecessary, assuming a clean exciter. Therefore, a low Q is acceptable. In theory, maximum tank circuit efficiency is with a Q of zero. This means no circulating current losses. Excessively high Q values can result in serious circulating current losses and can require very large components to handle the losses.

"Q" is defined in several ways. The more common is the ratio of the reactance of either leg of the tank to the series losses of the circuit including the coupled losses or load. Likewise it is defined as the ratio of the shunt losses, including the load, to the reactance of either leg. Another very useful way of defining "Q" is the ratio of the tank circuit volt-amperes to the output watts.

This last definition is particularly useful as the values are readily available to us.

For example let us design the tank for a 1 KW input CW or AM amplifier. For purposes of harmonic attenuation the desired value of Q is 12. Assuming 65% efficiency for good stability, the output will be 650 RMS watts. From the formula Q=VA/Output, we find that Q x Output = VA. 12 x 650 = 7800. Therefore, we will need a tank circuit with 7800 RMS volt-amperes in it.

The peak rf voltage in a properly loaded Class C rf amplifier is very nearly 90% of the dc plate volts. If we decide to use 3000 volts on the plate of the amplifier, the peak rf volts will be 2700. The RMS volts will be 1900. With the tank circuit volt-amperes equal to 7800 and the tank circuit volts equal to 1900, we find the tank circuit circulating current is 4.1 amperes RMS (7800/1900).

The reactance of either leg of the circuit must equal E/I so X_c = 1900/4.1 or 465 ohms.

Of course you can calculate the capacity whose reactance is 465 ohms at the operating frequency using the regulation formula

$$X_C = \frac{I}{2 \pi F(C)}$$

or you can use reactance charts, reactance slide rules, etc.

As a check on your calculations, use the basic figures 100 mmfd equals 100 ohms at 16 mc (actually 15.9 mc). From this basic figure, you can go up or down. For instance at 4 mc, one-fourth of basic frequency, 100 mmfd is four times the reactance, or 400 ohms. Or at 32 mc, twice the basic frequency, 100 mmfd is 50 ohms. At 32 mc 25 mmfd would be 200 ohms, etc.

Using this rule of thumb, it can be seen that 465 ohms at 4 mc will be in the vicinity of 100 mmfd. It calculates out to be 90 at 3.8 mc. The above calculations were based on several approximations so there is no reason to assume that the calculated 90 mmfd is appreciably better than the rough calculated 100 mmfd. The value is not that critical. So we can say that about 100 mmfd of input condenser and enough coil to resonate with it will be OK for our 1 KW amplifier with 3000 volts on the plate. Further, we will have about 4 RMS amperes of circulating current in the tank when properly loaded. So the tank coil will be required to "keep cool" with 4 RMS amperes tickling it. More on this later.

The tank circuit of an amplifier functions as an impedance transformer between the tube and its load. In the amplifier under discussion, the plate impedance that the tube would like to see is between 4500 and 5500 ohms depending on what rules of thumb are used and what assumptions are made. If this amplifier is to see the usual 50 ohm load, we need an impedance transformer of about 5000 to 50 ohms or an impedance ratio of about 100 to 1.

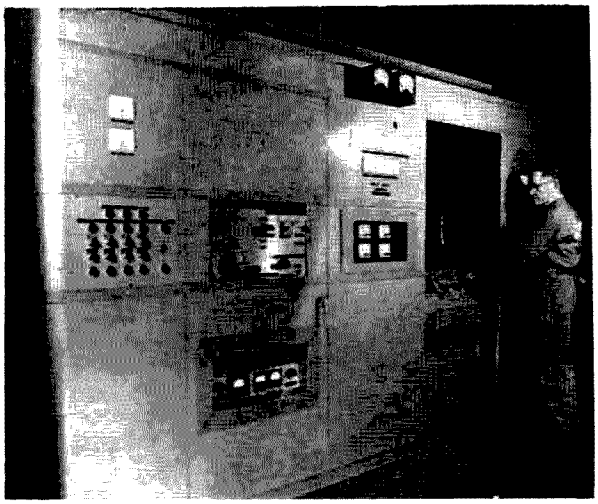
With a Pi net output circuit, there is a minimum Q, below which the network will not function as a Pi net, but will function as an L net. This will result in the output condenser of the Pi net losing control of (having no effect on) the loading. This minimum value of Q is approximately equal to the square root of the impedance ratio of the output circuit.

$$Q_{min} \cong \sqrt{\frac{R_P}{R_L}}$$

R_P = PLATE IMPEDANCE
R_L = LOAD OR ANT IMPEDANCE

In the amplifier being discussed, with an impedance ratio of 100, the minimum Q for a Pi net would be approximately 10. A design figure of 12 was used so that is OK for this case.

However, in a linear amplifier the high Q is not required for harmonics attenuation; is



undesirable due to circulating current losses, and is undesirable from the standpoint of broadbanding. If a lower Q is used, the amplifier may be used over a wider range of the VFO without returning the amplifier. A "Q" of the order of 3-5 is desirable from the standpoint of tank circuit losses and broad banding, provided no problem of harmonics is present. This is usually lower than can be obtained with the usual high impedance tubes in use.

Four 811A tubes with 1500 volts at ½ amp peak plate current could be run as low as Q = 6. This would calculate to be 140 mmfd at 3.8 mc. This linear amplifier has been built and put into operation at "Doc" Jack Vogelman's QTH (W6CJY), and works fine.

The accompanying nomograms may be used to determine the values of capacity, voltage, current, or frequency necessary in designing a tank circuit. When any three of these four variables are specified, this automatically determines the fourth.

One nomogram works with capacitive reactance, frequency, and capacity. Given two of the variables, it will determine the third.

One nomogram works with rf current, rf voltage, and capacitive reactance. Given two of the variables it will determine the third.

A straight edge laid across either of these nomograms connects the three values that will satisfy the equation.

$$X_C = \frac{I}{2\pi F(C)} \qquad I = \frac{E}{X_C}$$

Peak values may be changed to RMS values by multiplying RMS by .707 or ½ $\sqrt{2}$. RMS values may be changed to peak values by multiplying by 1.414 or $\sqrt{2}$.

RMS = .707 Peak

Peak = 1.414 RMS

RMS values are 70% of peak values and peak values are 41% higher than RMS values.

Tests have been run on various sizes and types of rf coils to determine their current rating. It was arbitrarily decided to rate them at the current that would bring them to a stable 188°F without extra cooling, such as blowing, etc. Even a small air movement over the coil increases its rating (as here defined) appreciably.

The coils were tested by resonating them with a parallel condenser and coupling them to the tank coil of a test transmitter. Then the current was measured at the level that just brought the coil temperatures up to 188°F.

Note that the current rating at 16 mc is only about 60% of the current rating at 2.5 mc. The charts are for normal convection cooling, (not forced air). Note also that the spacing between turns has a great deal to do with the current rating. The larger conductors, due to circulating current in the capacitance between turns, do not carry proportionately more current.

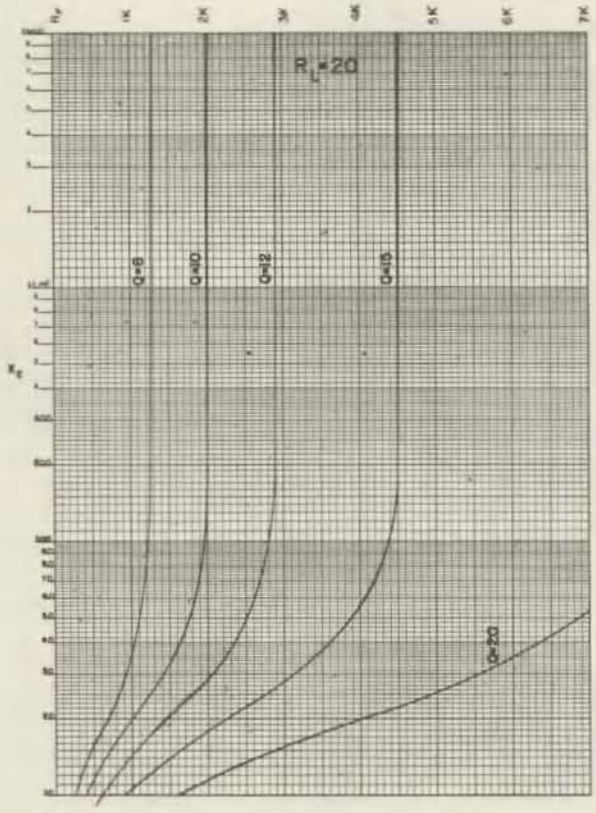
Figure 1 is a general view of the 100 KW bandswitching 2.5-25 mc SSB rig of the Jennings Radio Frequency Testing laboratory on which the coil tests were run. The operator is Lloyd Saxon, W6EEX, who largely built the rig.

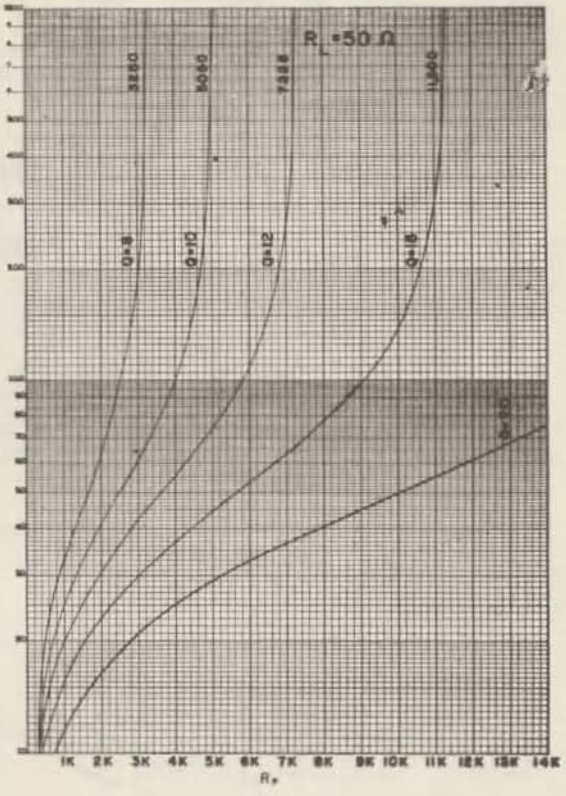
Figure 2 is a close-up of the testing cabinet of the rig where the actual tests were performed.

It is permissible to consider the duty cycle involved when selecting the proper coil size according to its current rating. For instance an AM rig would probably be considered 100% duty cycle, so a heavy continuous duty coil would be necessary. For CW or SSB, a 25% to 50% duty cycle could be used. Therefore, a smaller coil and resulting space saving could be used.

By using a low "Q" circuit, a little air (possibly diverted from the tube fan) and a short







duty cycle, a very small coil will do a big job.

In this space age, miniaturization seems to be the rule. Of course this requires some compromising. Smaller coils certainly have greater losses, but DB-wise, at the receiving end of a signal the losses are negligible. Even losing half the output of a rig (horrors) is almost undetectable at the receiving end.

Another space saver that works well on 20, 40, and 80 meters (but not too well on 10 and 15 meters) is to tap up a few turns from the grounded end of a parallel tuned plate circuit,

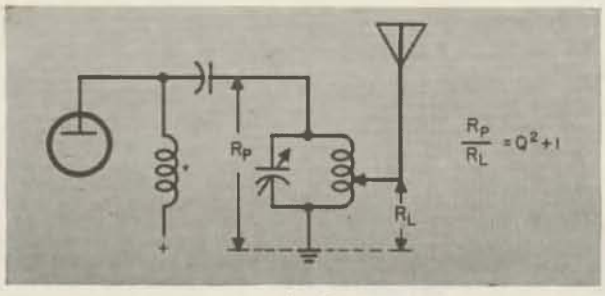


Fig. 3

for the load. Proper loading is adjusted by moving the tap. (Figure 3). This eliminates the output condenser of a Pi net. This system, a form of an L net, should only be used where harmonic attenuation is not a factor (linear amplifiers). It has been in use at W6JAT in a bandswitching 4CX2000W SSB final for two years. A complete new tank is switched in for each band.

The foregoing will determine the tuning condenser of a parallel tuned tank circuit or the input condenser of a Pi network. It is probably more practical to cut the coil by setting the condenser to the proper value and use a grid dipper to determine the amount of coil to hit resonance.

A Pi net is actually two L nets, back to back, but the amount of inductance in the output L net is low, and the C is high, so turning the output condenser of a Pi net to max. and setting the input condenser at the proper calculated value will give only a small error in grid dipping the coil. The coils do not have to be grid dipped in the set with the transmitter input condenser. They may be dipped on the bench using any convenient proper value condenser. Then transfer the coil to the transmitter, without changing its physical dimensions.

However, you often can not get by so easily

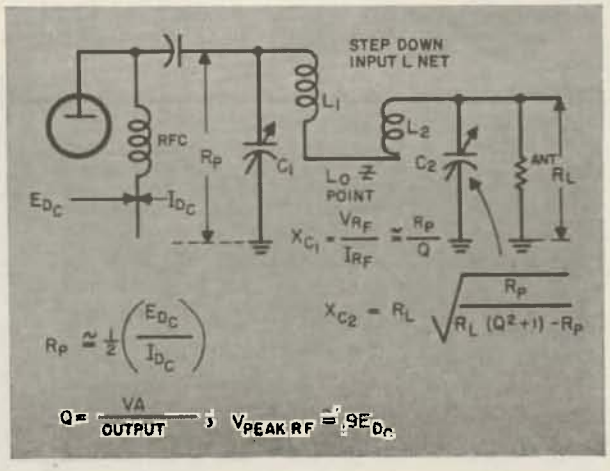
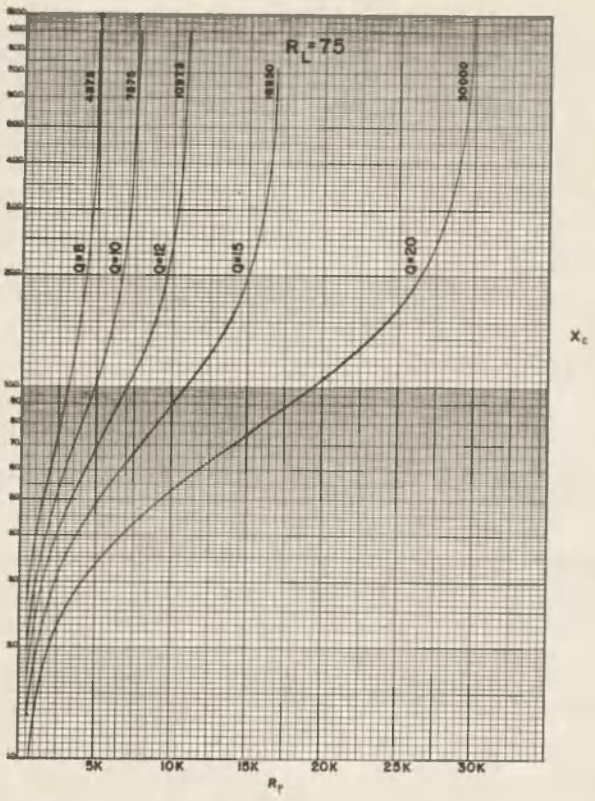
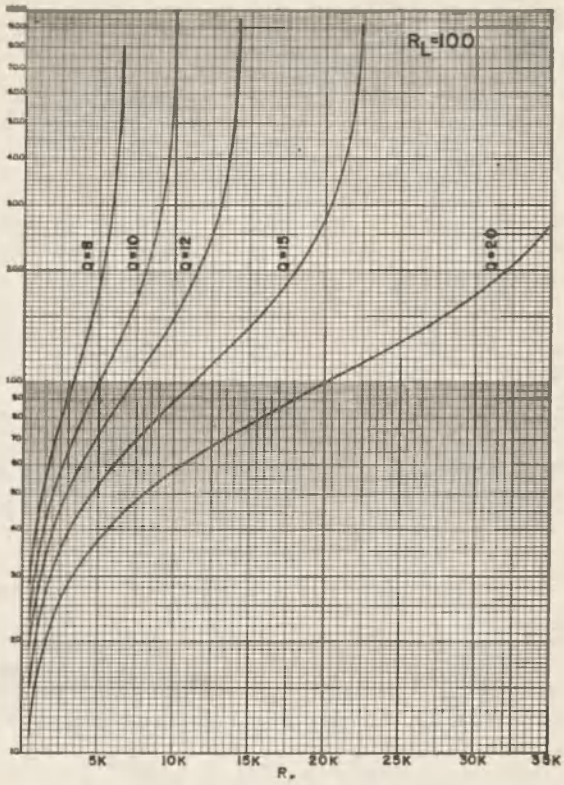


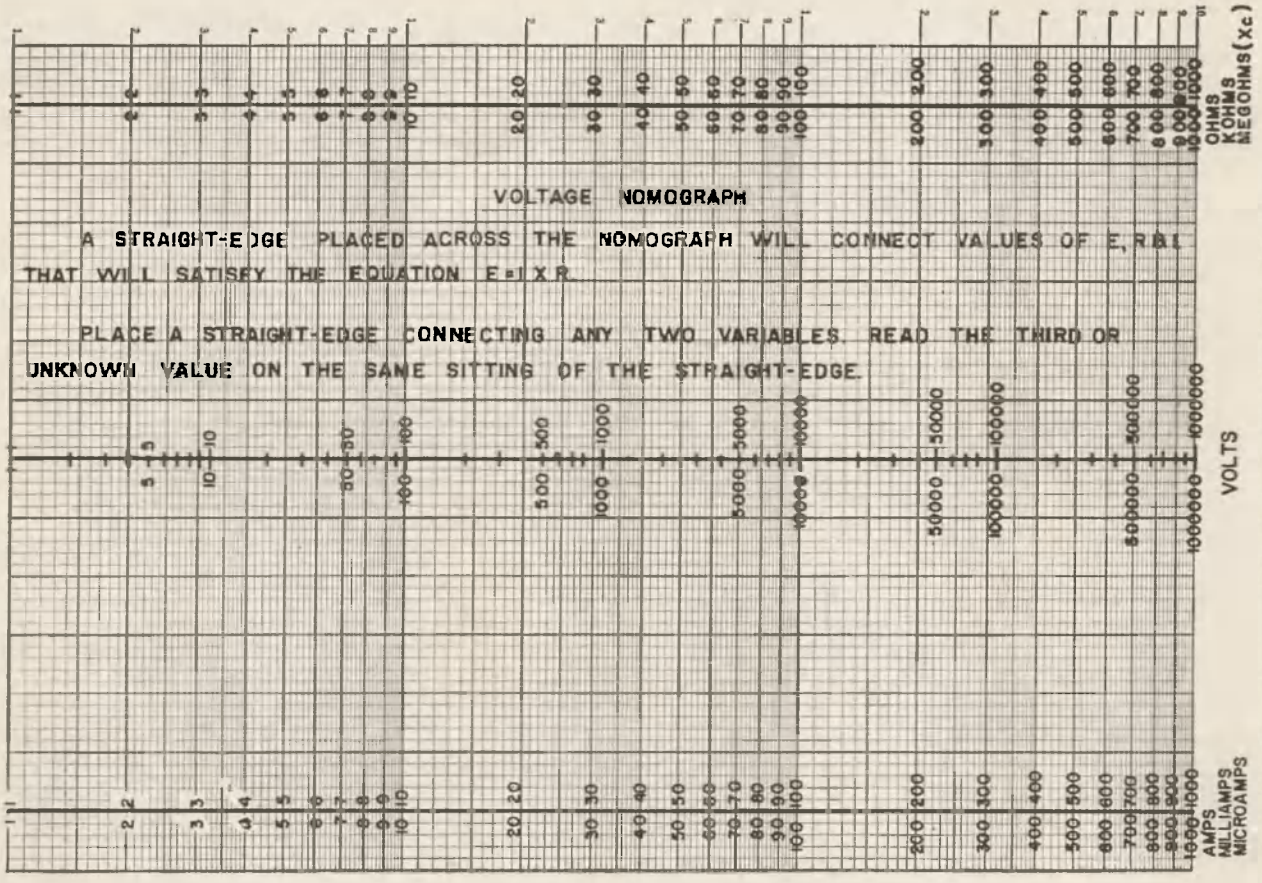
Fig. 4





on the 10, 15, and possibly 20 meter bands, as the calculated input capacitance values are usually lower than the output capacitance of the tube, plus stray wiring capacitance. Therefore, you will have to operate at the lowest value of the tuning condenser that will give you a little tuning control, minimize stray wiring capacitance, then cut a coil with the grid dipper. The resulting coil will have a higher "Q" than the calculated value.

For determination of the value of the output capacitance for a Pi net, the standard



Current test of various Illumitronics air wound ribbed coils of tinned copper wire except one #11B & S aluminum wire.

F. MC	Coil diam.	Wire size	Turns spacing	I RMS
2.5	2½"	#12	5/32"	6.5 A
2.5	3"	#10	¼"	11 A
2.5	2½"	#17	3/32"	2.7 A
2.5	3"	#11	¼"	10 A
2.5	3"	#10	3/16"	8.5 A
2.5	3"	#11 alumin.	3/16"	8 A
2.5	3"	#14	⅛"	4.5 A
2.5	3"	#11	5/32"	8.5 A
16	3"	#11	5/32"	3.5 A
16	3"	#10	¼"	6.3 A
16	2 1/5"	#14	¼"	4.5 A
16	3"	#10	3/16"	5.3 A

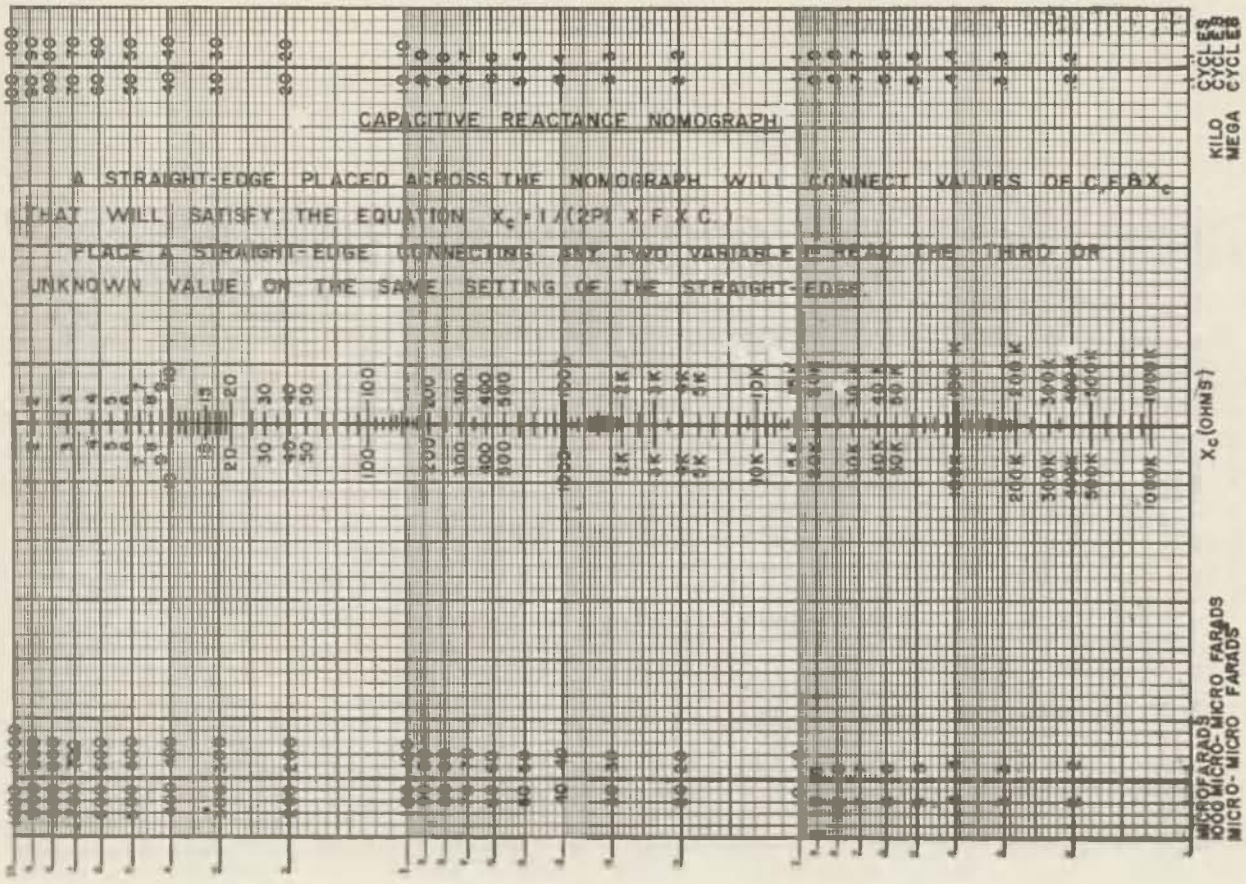
Current test of copper tubing air wound rf coils.

F. MC	Coil diam.	Tube size	Turn spacing	I RMS
16	3"	3/8"	3/8"	14
16	3"	¼"	5/8"	11.5
16	3"	¼"	7/16"	10
16	3"	¼"	3/8"	8
16	3"	3/16"	5/8"	10
16	3"	3/16"	½"	9
16	3"	3/16"	3/8"	8
16	3"	3/16"	¼"	6.3
16	3"	⅛"	5/8"	8
16	3"	⅛"	½"	8
16	3"	⅛"	3/8"	8
16	3"	⅛"	¼"	7
16	3"	⅛"	3/16"	5.3
2.5	7"	3/8"	1/8"	30
2.5	3"	¼"	5/8"	20
2.5	3"	¼"	½"	18
2.5	3"	¼"	5/8"	20
2.5	3"	¼"	½"	18
2.5	3"	¼"	3/8"	17
2.5	3"	3/16"	7/16"	16.5
2.5	3"	3/16"	3/8"	15
2.5	3"	3/16"	3/16"	14
2.5	3"	3/16"	¼"	9.5

handbook formula seems to be quite satisfactory. If the output condenser of a Pi net fails to control the load properly (assuming a proper load), the trouble is probably that the Q is too low. It may be corrected by taking off a turn or two of coil and increasing the input condenser.

It pays to check the actual efficiency of an amplifier. If the efficiency is below about 60% it may well be that the Q is too low. Again reduce the inductance and increase the input capacitance until reasonable efficiency is obtained.

In tuning a Pi net, consider that the output capacitor is shunting the rf to ground. Start



with maximum capacity on the output or loading capacitor. Tune the circuit to resonance with the input capacitor. Note the deep plate current dip. Do not stay at this point long unless you have a heavy duty tank coil. Reduce the output capacitor, thereby shunting less rf to ground and more rf will remain available for the load. Redip the plate current of the final. Continue reducing the output capacitor and redipping the final until proper loading is obtained.

An examination of the graphs for determining the output condenser of a Pi net may explain why Pi nets sometimes become balky or refuse to cooperate the way we think they should.

Suppose we have a 3000 volt, KW rig, (one third amp). The plate load should be approximately one half the dc load the power supply sees. This figures out to 4500 ohms Rp. If the antenna is actually 50 ohms (happy day), a Q of 15 would work well and even a Q of 10 would be OK. But if the antenna were to present a load of only 20 ohms to the amplifier, a common possibility, (SWR 2.5), a Q of 15 would barely make it, and any lower Q would refuse to load. Solution: either correct the load or increase the Q.

The graphs also show that high impedance tubes require a high Q for operation of a Pi net. If a broad tuning amplifier is desired, a low Q is necessary, and this dictates low im-

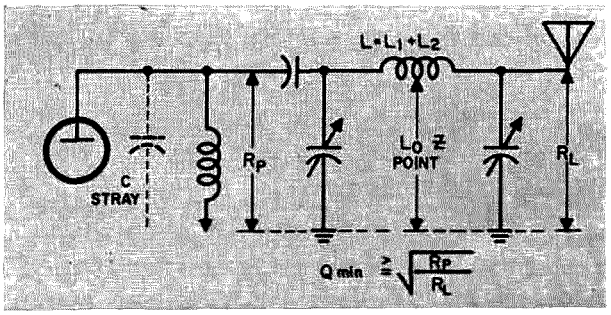


Fig. 5

pedance amplifier tubes.

For example, from the Eimac catalogue, two 304TL tubes could be run as a linear amplifier at 1500 volts and 1140 ma. This figures a plate resistance of about 650 ohms. Now a Q of 8 could be used. This would result in a linear amplifier that would broadband across most of an amateur band. . . . W6JAT

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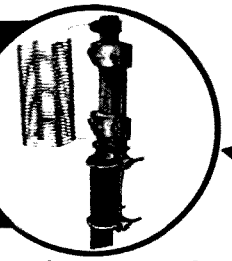
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Converting 6 Volt Radios To 12 Volts

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SINCE 1954-55 most automobile manufacturers have changed over to 12 volt systems, with the result that thousands of 6 volt radios are available for next to nothing from used car dealers, junk yards and radio repair shops. In addition many hams have 6 volt mobile units which are useless on the newer 12 volt cars unless a complete conversion job is performed on them. Most amateurs hesitate to attempt a 6/12 conversion either because of the work involved or else because of the expense. The purpose of this article is to illustrate an extremely economical conversion method and at the same time one that is not beyond the ability of the average ham.

The author has converted a considerable number of 6 volt units to 12 volt operation, including such transmitter-receiver units as the Link 2365, which uses a dual transformer, dual vibrator, voltage doubler power supply; the Link 2210 which uses a single transformer, single vibrator, voltage doubler power supply; Motorola FMAR-13V and Link 35-UFM receivers, which use conventional full wave vibrator power supplies; and a number of broadcast receivers such as the Motorola 505, which is the subject of this article.

In each instance the performance has equaled the original 6 volt performance. Some of the Link and Motorola units have seen 24 hour a day police service for the past couple of years and the 12 volt conversion has been in every way equal to the original 6 volt system.

While the unit covered here is the Motorola 505 broadcast receiver, the principles involved are adaptable to just about any piece of mobile radio gear using vibrator type power supplies. Of particular interest to hams is the conversion of broadcast receivers since many mobile units consist of a multi-band converter working into a regular broadcast receiver. However, the amateur should not overlook the many bargains now available in commercial 2 way gear of the 6 volt variety as these units make excellent RACES, AREC or amateur net units and many of the ham clubs around the country are beginning to set up 10, 6 or 2 meter nets using this type of equipment.

Details

Examine the filament circuit and the general wiring layout. At this point begin the rewiring of the filaments for series-parallel operation. Keep in mind that it is not necessary to rewire each filament pin since one pin of each tube filament is already grounded and the other is hooked to the hot "A" line. It is only necessary to break the hot line to the first tube and the ground connection to the 2nd tube and connect a wire between these two pins. Fig. 1 gives the before and after circuit of the filament wiring. Be careful to obtain the 12 volt filament current from the same point as the original 6 volt current was obtained in order to take advantage of the hash interference chokes, etc. In the case of the 6X5 rectifier tube you will not be able to follow this exactly as the 6X5 filament power was originally obtained from a different tap on the circuit from the other tubes. Also, since the 6X5 and 6V6 must be paired together and there is a difference of .15 ampere in the filament current it will be necessary to parallel the 6X5 filament with a 39 ohm 2 watt resistor (the figure actually works out to 40 ohms but 39 ohms is the nearest stock resistor and for this purpose is close enough).

Modifying The Vibrator

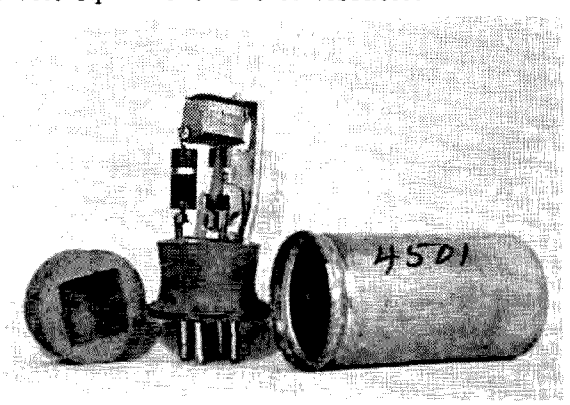
Of course the simplest way here would be to merely replace the 6 volt vibrator with its 12 volt equivalent. However, this requires a needless outlay in cash as the old vibrator probably has a considerable amount of useful life remaining.

Remove the vibrator from its socket. With a pair of side cutting pliers, carefully pry open the crimped edge of the bottom of the vibrator can and remove the vibrator assembly from the can. Remove the sponge rubber cap from the top of the vibrator mechanism and carefully examine the parts arrangement. At the top of the assembly you will find a small coil of wire, one end of which will be attached to the vibrator frame. From the other end of the coil you will note a wire running either to a separate pin on the vibrator base or else to the same terminal point as one of the vibrator contacts. Cut this wire and with an ohmmeter measure the resistance of the vibrator drive coil. This will usually average from 9 to 15 ohms (15 ohms in the vibrator in the 505 modified here). After determining the resistance of the coil, determine by Ohms' law the amount of current it will draw at 6 volts. This is determined by dividing the 15 ohms resistance into the 6 volts, which gives a result of .4 amperes of current. Multiply the .4 ampere

current by the voltage to obtain the wattage, which in this case is 2.4 watts. Actually the current drawn during operation is less than this amount due to the fact that the vibrator is constantly interrupting the flow of current through the coil. Measurements taken here indicate a duty cycle of about 40% as the current actually being drawn by the coil was 160 ma. Therefore our actual wattage is .96 watts and a 2 watt resistor is more than adequate.

Solder this resistor between the same points originally connected by the wire removed in the preceding operation and position the resistor so that it will not short to the vibrator frame. Replace the sponge rubber cap on the mechanism and reinsert the vibrator into its can. Re-crimp the edge of the vibrator can over the insulated base plate and reinsert the vibrator in its socket.

This completes the vibrator modification and will permit using the 6 volt vibrator on a twelve volt system to the end of its useful life. When the modified six volt vibrator finally "gives up the ghost" merely replace it with the 12 volt equivalent. To make sure that someone does not accidentally replace it with an unmodified 6 volt vibrator it is suggested that a printed tab be pasted on the vibrator can stating, "This vibrator has been internally modified for 12 volt use. When it becomes necessary to replace this unit, do so with the 12 volt equivalent of this vibrator."



Note: Some vibrators use a series drive coil which is connected to a separate pin on the base plate. The 505 is wired to use either the series or parallel type vibrator and with the series drive type of vibrator it is possible to wire the resistor into the circuit under the chassis by putting it in series with the wire running to the vibrator pin feeding the drive coil. This will eliminate the necessity of opening the vibrator can but it will require that all future replacements be made with 6 volt vibrators. Since this actually results in slightly more current being drawn from the battery than the straight 12 volt vibrator and also due to the ensuing confusion from having to replace a vibrator on a 12 volt system with a 6 volt vibrator it is suggested that the resistor be mounted inside the vibrator can.

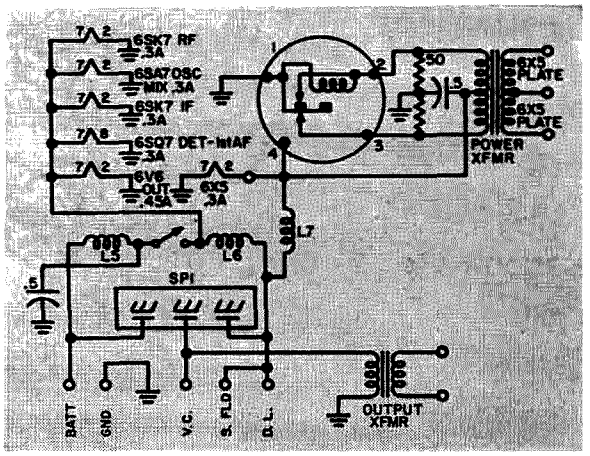


Fig. 1A

Modifying The Transformer

The transformer in the Motorola 505 is of the potted type and is held to the chassis by 4 self tapping screws which run through the chassis and up into pre-formed slots in the corners of the transformer cover. Examine the underside of the chassis and make a sketch of the placement of the transformer wires and the color coding on each wire so that you can re-attach the wires of the modified transformer to the correct points. Cut or unsolder each wire from the pin or tie point to which it is attached, remove the 4 self tapping screws and remove the transformer from the set. Remove the piece of cardboard from the inside bottom of the transformer can and chip away enough of the transformer pitch to enable you to get hold of the transformer core with a pair of pliers. Be careful not to damage any of the wires or insulation. Next, place the transformer, open end up, in an old coffee can or other container and "borrow" the XYL's hot plate for a few minutes. Take the hot plate and transformer outside or into a work area as the next step will create some slight smoke and fumes. Place the can containing the transformer on the hot plate and turn it on. Watch the operation closely as it will not take too long for the pitch to heat sufficiently to allow you to grasp the transformer can with one pair of pliers and the core with another pair of pliers and pull the transformer out of the can. Do not pull on the wires during this operation as you may tear the paper insulation or even pull out a wire or cause a short in the secondary. The primary is not important at this point as we are going to discard it anyway. After removing the transformer from the can, carefully chip away all the pitch still remaining on the metal and paper parts of the transformer. Now examine the transformer laminations carefully.

Take a blunt chisel or punch and carefully tap the outermost lamination out of the transformer winding. After the first one is gotten out on each side the job will loosen up and go

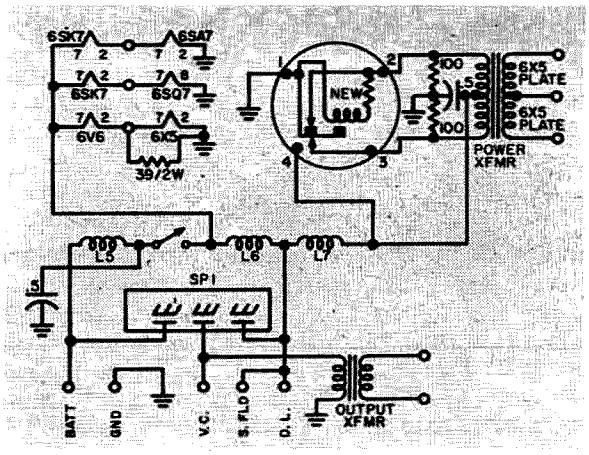


Fig. 18

a little easier with the remaining ones. Remove the "E" and "I" sections one at a time and lay them temporarily aside.

The above steps have completed the core disassembly and we are now ready to go to work on the windings. On the 505 transformer modified here the primary winding was on the inside next to the core. However, this may not be the case on all units as some have been found with transformers which had the primary winding on the outside and the secondary inside next to the core.

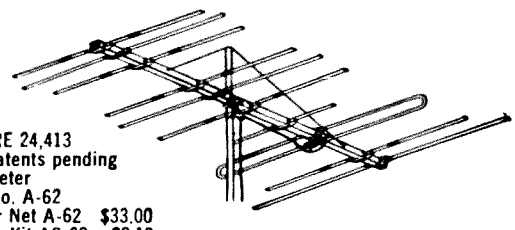
If the primary winding is on the outside in your unit you merely have to remove the outer layer of paper to reach the end of the outermost winding and start unwinding. However, if your unit is like the one here and has the primary winding on the inside, then you will have to proceed as follows to avoid destroying the center winding form.

Locate the innermost end of the primary winding and note its color code. (1) Carefully start to pull this wire out the side of the winding and keep careful count of the number of turns pulled out. With a little care the wire will pull out the side as it unwinds. After the first layer is unwound you will be able to pull the inside cardboard form out and can then proceed a little more rapidly. Keep count of the turns until you reach the center tap and at that time note the color code on the center tap and the number of turns you have removed. (2) Make a written record of this as you will need the information later when you start to rewind the core. Proceed from the center tap on to the other end of the winding and again note the color code. (3) This has completed the disassembly of the winding.

The 505 six volt transformer is originally wound with #18 Formvar enamel covered copper wire, and has a total of 28 turns each side of the center tap. Since we want to operate the rewound transformer on 12 volts, the current will be cut in half. We therefore want to rewind the transformer primary with twice the number of turns but with wire of half the size. In order to cut the size of the wire in half we must move 3 wire sizes. Most radio sup-

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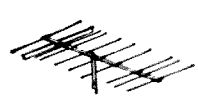
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Amateur Net $17.16
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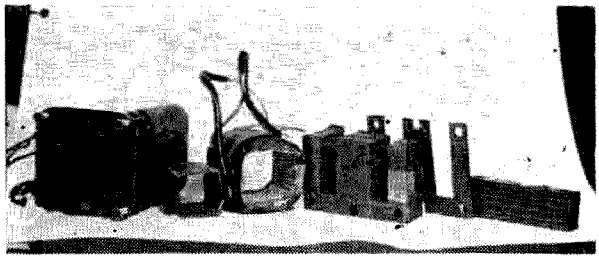


A2-10 2 Meter 10 Element
Amateur Net $11.88
Stacking Kit AS-2 $1.83



A1¼-10 1¼ Meter 10 Element
Amateur Net $11.88
Stacking Kit AS-1¼ $1.26

See Your FINCO Distributor
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THE FINNEY COMPANY
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ply houses stock only even numbered sizes so we will rewind our transformer with either #20 or #22 wire and our rewound primary will consist of 56 turns of #20 or #22 wire each side of the center tap or a total of 112 turns in all.

Saw out or otherwise obtain a wooden block about 8" long and of a width and thickness sufficient to snugly fit the inside of the square cardboard tube removed from the center of the coil.

Select an 8 inch length of insulated hookup wire of the same color as the lead attached to the #3 end of the original winding and attach this to the end of the #21 wire with which you are going to rewind the coil. Attach this wire to the cardboard form with Scotch tape. Start the winding about one eighth inch in from the edge of the cardboard form but allow the insulated wire to run the first half inch of the first turn. Proceed with the winding, being careful to keep the turns tight and close together but not overlapped. When you reach a point one eighth inch from the other end of the cardboard tube, hold the winding securely and wrap a single layer of either transformer paper or a good grade of thin linen cloth around the wire layer wound so far. Now continue the winding being sure the turns continue in the same direction around the coil form but lapping the winding back over the layer just completed. When you reach the 56 turn point, bring the wire out of the coil for a distance of eight inches, make a sharp bend in the wire and take it back into the coil. Twist this 8 inch lead to make a "pigtail" and slide a piece of spaghetti over this double center tap, being sure to use the same color spaghetti as the original center tap in step 2, and continue the winding. Take care to adequately insulate the center tap lead and make sure that you continue the second half of the winding with the turns going in the same direction as the first half. When you have completed another 56 turns, securely fasten another 8 inch lead to the end of the wire. Use the same color lead as the lead removed from the original primary in step 1. In making all of the taps be sure to scrape the wire clean of the enamel covering before soldering, otherwise you will have a poor connection or no connection at all. Place a layer of transformer paper or thin linen cloth over the winding just completed and secure the entire assembly with Scotch tape. Take a piece of hard plastic or a rubber mallet and gently tap the sides of the winding to make them as nearly square as possible. Now reinsert this completed winding back into the inside of the secondary which we have not disturbed. If it tends to fit loose, work shims of paper in between the two windings to make a snug fit.

Reassembling The Core

Insert one of the outside "E" laminations (one of the two long ones) into the core. Now, from the opposite side insert another "E" lamination and place an "I" lamination across its end to close the "E". Continue this process by running the "E" and "I" laminations in from alternate sides so that every other "E" lamination comes in from the right with an "I" on the left and the remaining "E" laminations come in from the left with an "I" on the right. When all regular size laminations have been replaced, carefully slide the remaining long lamination back into place. This completes reassembly of the core.

Place the transformer back into the can and shim up the sides with paper or thin cardboard to make a snug fit. Dress the wires out of the can at the same position as the original wires and replace the cardboard bottom plate in the can. Replace the 4 self tapping screws and re-attach the wires to the same points from which they were removed. This completes the modification of the transformer and since the secondary was not bothered and the primary turns were increased by the same ratio as the primary voltage, we do not need to change the buffer condenser.

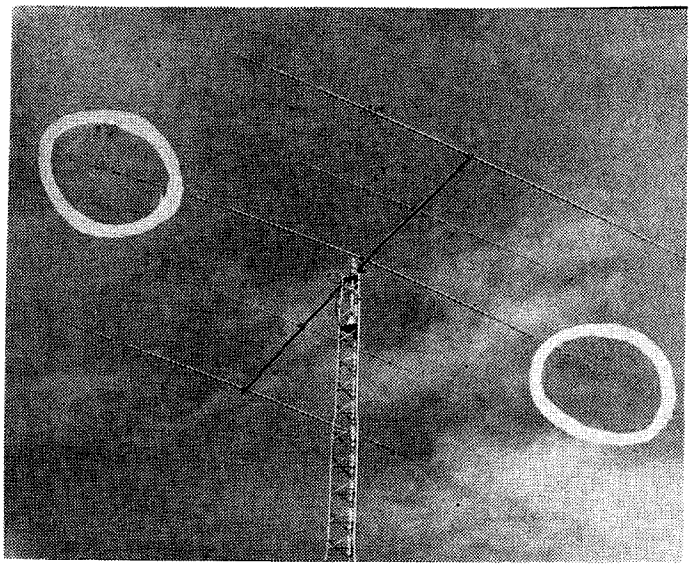
The only remaining changes to be made are as follows: The vibrator pins to which the outside ends of the transformer primary winding is attached, each have a 50 ohm ½ watt spark suppression resistor from the contact to ground. Replace these with 100 ohm 1 watt resistors, and physically position the replacements as nearly as possible in the same position occupied by the original resistors. Replace the pilot light bulb with a 12 volt equivalent and replace the fuse with one of half the amperage rating of the original.

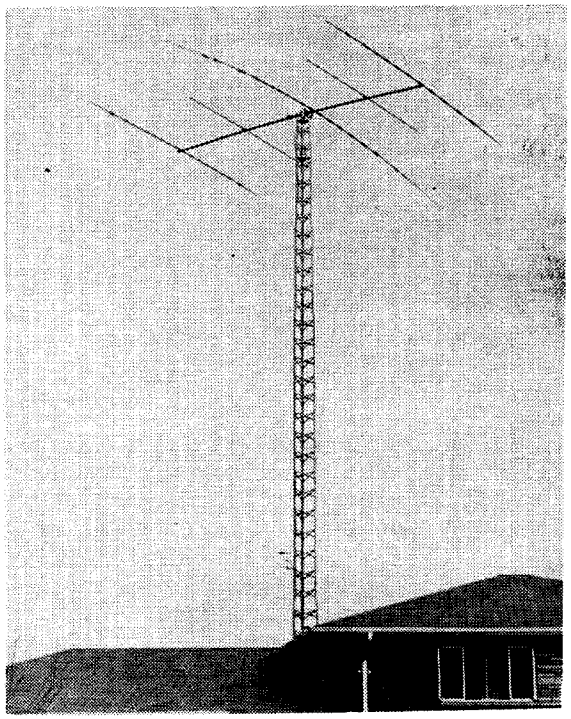
This completes the conversion from 6 to 12 volts and the receiver will equal its original 6 volt performance in every way.

COST:

One 39 ohm 2 watt filament balancing resistor	.24
One 15 ohm 2 watt vibrator modification resistor	.24
Two 100 ohm 1 watt spark suppression resistors @18¢ ea.	.36
One fuse	.12
One 12 volt pilot bulb	.17
Enamel covered wire for rewinding primary	.22
Total	$1.35

. . . W4OHM





VIEWS OF TRI-BAND ANTENNA AT WOJRQ IN DENVER, COLORADO, WITH "SPACE-GUNS" ADDED FOR 40 METERS



WOJRQ (MACE WARNER) SAYS:

GET A PAIR OF SPACE-GUNS

THEY'RE HOT AS A PISTOL

Put them on the ends of your Tri-Band Beam's driven element and work forty meters to your heart's content at night when 10 - 15 - 20 are dead as a door nail. Also works swell on any 20 meter beam where the driven element is fed straight with co-ax and does not use a gamma match, etc. They are light weight but extremely sturdy and do not affect operation of your Tri-Band Beam on 10 - 15 - 20 for all practical purposes — gives you four band operation on one feed line — gives you a rotatable dipole on 40 meters with a figure "8" pattern and horizontal polarization with a reasonable angle of radiation giving you less noise and less TVI and more enjoyable QSO — good SWR on beams fed directly with 52 ohm line — Comes tuned for center frequency on 20 at 14,275 KC and on 40 at 7,200 KC for height of 35 ft. and up — easily adjusted to any other two center frequencies in the two bands — the "Q" is low enough so that the tuning is quite broad—**Price $39.95 A Pair P.O.B.**

(Patent and Copyright applied for.)

NETTLES MANUFACTURING CO.

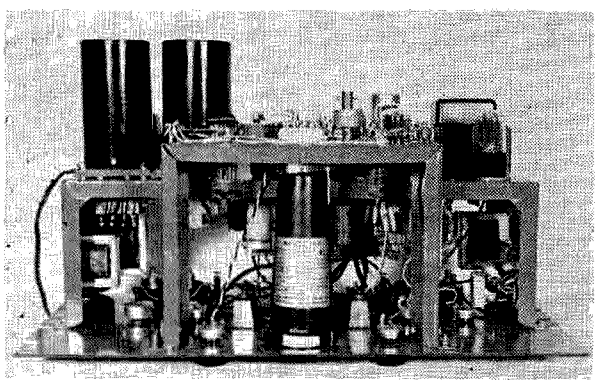
P. O. BOX 614

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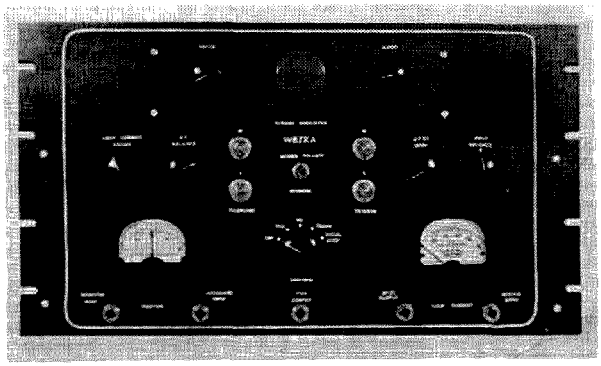
RX for the RTTY Bug

Louis Hutton WØRQF
2608 South Fern
Wichita 17, Kansas

A few months ago I attended a local radio club meeting to observe a demonstration of RTTY equipment. Although at the time I was only mildly interested, the RTTY bug bit me hard a few weeks later. Visits to several active RTTY stations gave me a better picture of just what was involved in a RTTY installation. From these visits, along with searching through the RTTY columns in back issues of CQ plus studying a well-worn copy of the RTTY handbook, I designed and built my terminal unit. The unit described in this article is serial number two that I built for WØZKA 'MAC', and will cost the builder about $100 if all new parts are used throughout.



This terminal unit has two polar relays in the output. One relay is used to control the printer and the other is for keying the FSK input of a transmitter. An AFSK oscillator[1] output is provided for VHF RTTY work or may be fed to the microphone input of a good SSB transmitter for high frequency FSK operation. An adjustable 110V dc power supply is built into the unit for printer operation. A scope type RTTY tuning indicator[2] was included to aid in fast accurate tuning. The 500 ohm output from the receiver is fed to a band pass filter[3] which limits the input frequency response from 2000 cycles to 3000 cycles.



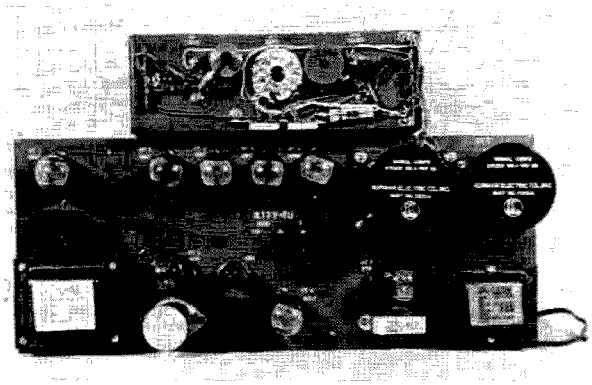
The circuit is a combination of the popular W2PAT[4] and W2JAV[5] systems. Front panel control is provided for all adjustments of the terminal unit. As with any W2JAV type terminal unit, good copy is possible with either the mark or space signal.

Construction

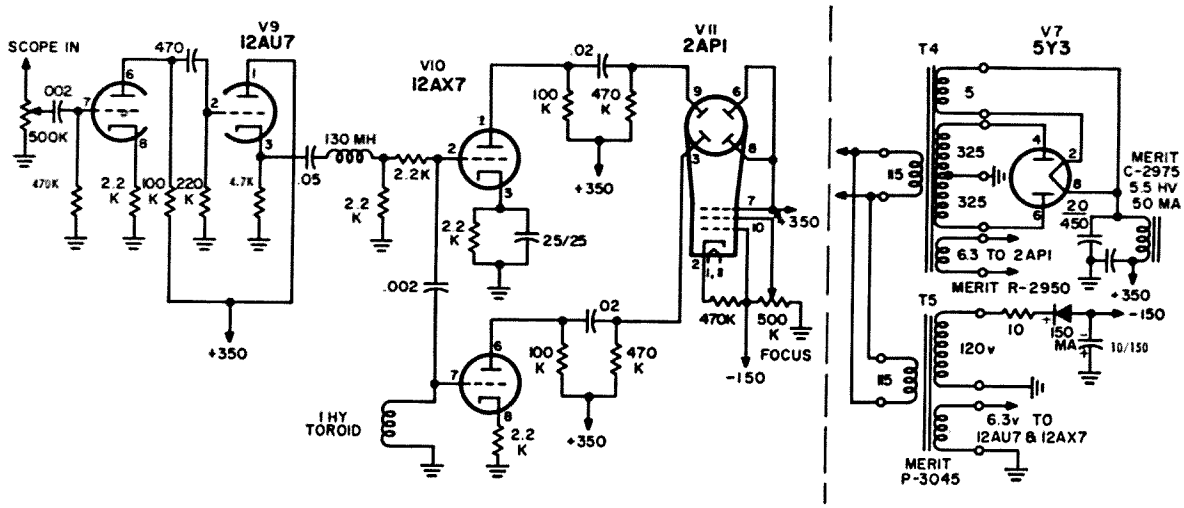
The front panel is 10½" x 19" x ⅛" hammertone gray finished aluminum. When the holes were all laid out and drilled, the panel was washed in soap and water to remove the grease and dirt. A thin ⅛ inch of strip of masking tape was applied to the front denoting the stripe. The panel was then sprayed with two coats of Krylon machine grey paint. When dry the masking strip was pulled loose revealing the stripe. After the panel components were assembled to the panel, the decals were applied and set.

The main chassis is a Bud panel Chassis CB-1373, and is 17" x 5½" x 7". The scope chassis was hand formed from aluminum and is 6" x 9" x 3". The condensers and resistors are mounted on terminal boards made by bolting long terminal lug strips on aluminum brackets. These are then fastened up-right next to the associated tube socket. After all the major holes were punched in the chassis, it was washed, painted with Krylon light grey, and decalled.

The toroids are attached to the chassis by long brass screws. The screw is insulated from the toroid by spaghetti tubing. A small square of scrap felt insulates the toroid from the



[1]Fig. 4 AFSK Oscillator Schematic Diagram CQ, April, 1958, page 45.
[2]FSK Tuning Indicator—RTTY Handbook, Green and Kretzman, page 65.
[3]W2JAV Input Filter—RTTY Handbook, Green and Kretzman, page 72.
[4]An inexpensive radio teletype converter W2PAT QST, January, 1953.
[5]An Improved Radio Teletype Converter W2JTP CQ, April, 1958, page 42.



Tuning Indicator

metal chassis. After the front panel and chassis are prewired, check for proper wiring and soldering. If you are like me, I missed a few solder connections. The tuning scope was wired next but was not attached to the front panel until the main chassis was tested and adjusted for proper operation.

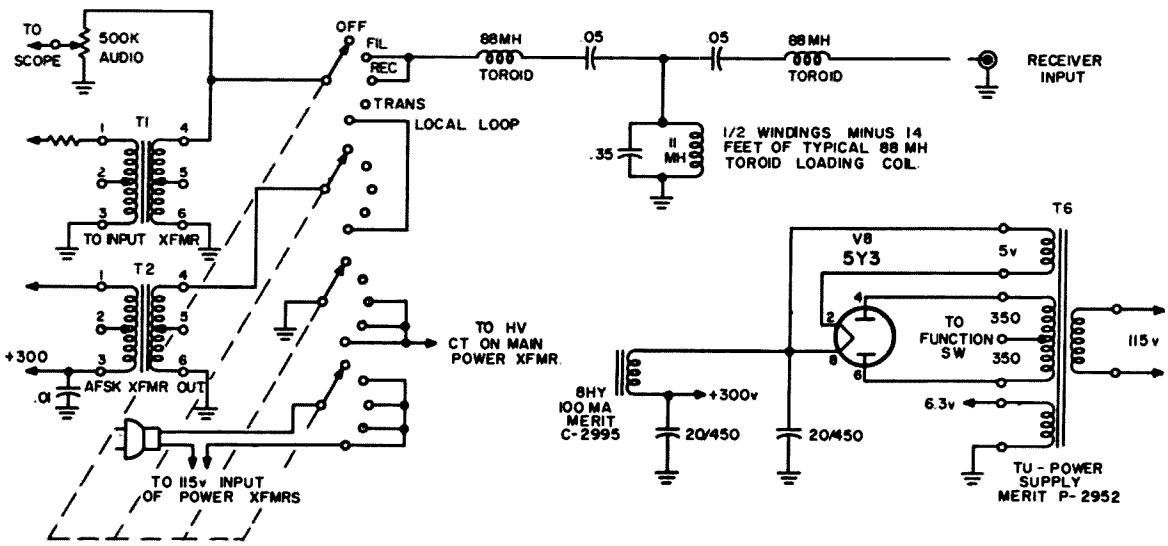
Adjustment

When the front panel has been attached to the main chassis, plug in the polar relays and all tubes, except the 5Y3 rectifiers. Turn on to "FILS" and check to see if all heaters light up. Then plug 5Y3 tube in the proper socket to provide high voltage to main chassis. Set function switch to "REC" and adjust "DC BALANCE" until the "TELETYPE" meter reads "O". Feed in receiver background noise to "RECEIVER INPUT" and adjust "INPUT BALANCE" till "M&S TRIGGER" lights glow evenly. Loosen and reset "INPUT BALANCE" pointer to center mark below title. Disconnect receiver background noise from "RECEIVER INPUT" and feed in test audio signal of either 2215 or 2975 cycles. I found that on both terminal units I built, the mark filter (2215 cycles) was correctly tuned but the space filter (2975 cycles) was low in resonant frequency. A slight amount of juggling in capacitor value was necessary to bring it up to the proper resonant frequency. This completes the adjustment of the TU.

Operation

To put the TU into service, connect the output of the receiver (500 ohms) to "RE-

(Turn to page 29)



Control Circuit

James L. Tonne W5SUC

Simplified Design Method for the Heising Modulator

THE Heising or choke-coupled modulator is one of the simplest plate modulators there is. Frequently, the junk box will provide all of the needed parts. But a complete design procedure covering every aspect takes of the order of an hour, and even an approximate solution assumes that all of the tube voltages are known, and further that a modulator tube of known characteristics is used.

Here is a design method which is simplicity in itself and involves only the simplest of calculations. It will yield a circuit design which technically is indisputably correct and conservative.

How to do it

First select the modulator tube. It should be a pentode or tetrode, with a plate dissipation rating equal to or greater than the power input to the modulated stage.

Next, connect the tube as shown in Fig. 1.

Finally adjust the cathode resistor until the plate current in the modulator tube is the same as the plate current in the modulated stage. That's all there is to it!

With the application of audio voltage as shown, the modulator will be able to modulate the modulated stage 100% in the upward or positive direction and about 90% in the downward or negative direction.

How to be sure it's OK

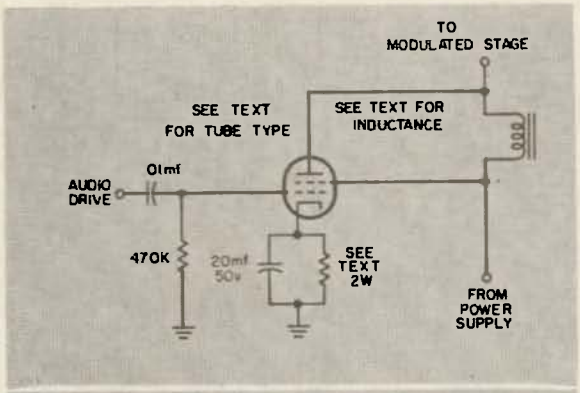
For long tube life, do not run more power into the modulator tube than its plate dissipation rating will allow. If you must use a tube of small plate dissipation as the modulator, you simply cannot run as much power into the modulator tube. The result will be a lower possible degree of modulation on the positive peaks. This will be true regardless of how much audio voltage is applied to the modulator tube. The graph of Fig. 2 shows the maximum modulation percentage obtainable in the upward or positive direction if you know the ratio of the modulator current to the modulated stage current. For example, if you run half as much current into the modulator as you run into the modulated stage, the modulation percentage in the upward direction cannot exceed 50%. The modulation percentage in the downward direction can peak at about 90% regardless of operating conditions. Of course these uneven percentages will result in some distortion. It is not the purpose of this article to debate the merits of various modulation percentages.

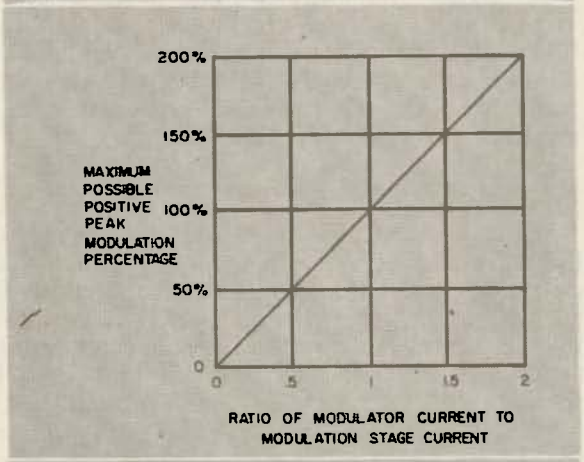
The choke must be able to handle the sum of the modulator and modulated-stage currents. Its inductance should be as shown in Fig. 3.

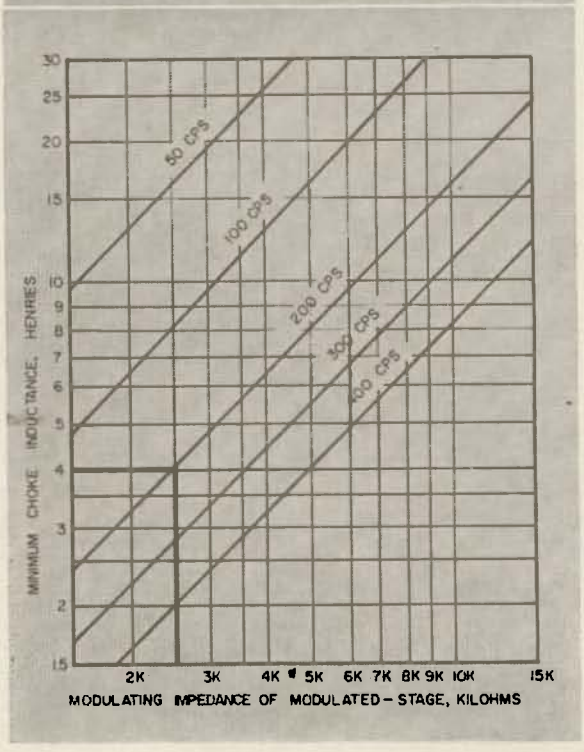
An Example

A modulated stage is supplied with 250 volts at a current of 100 ma. The lowest audio frequency of interest is 200 cps.

The modulator tube must be a pentode or a tetrode with a plate dissipation rating of 25







watts or more (250 volts times 100 ma.). The choke must have an inductance of 4 henries minimum, at a current rating of 200 ma (the sum of the modulator and modulated-stage currents). Remember that the power supply, too, must be capable of delivering this amount of current.

The typical audio drive voltage required by the modulator will be about 10 volts or so for tubes in the 25 watt category.

Sideband With Tuneable Converters

I'm sure that there are still a lot of the very good RME HF-10-20 converters and similar units around and in use. Moreover I'm also sure that the vast majority of these units are being used with older and poorer receivers with weak BFO's and, of course, no product detector circuits and the like.

Now! I'll wager that lots of these people would very much like to receive SSB #1. Cheap 2. Easy 3. Without receiver modification 4. WELL!

Here's the trick. V-e-r-y simple, and it works like a dream.

The HF 10-20 converts 10, 15, and 20 meter signals to a freq. of 6950 kc (can be varied slightly). Now, as everyone knows, there are two good ways of receiving side band signals. The first, and more or less standard way is to restore the carrier at the detector. The second is to restore the carrier in the front end. This has obvious disadvantages, since we like to tune around a bit. However, in this case, (you're way ahead of me) we're dealing with a single freq. (the conversion freq.).

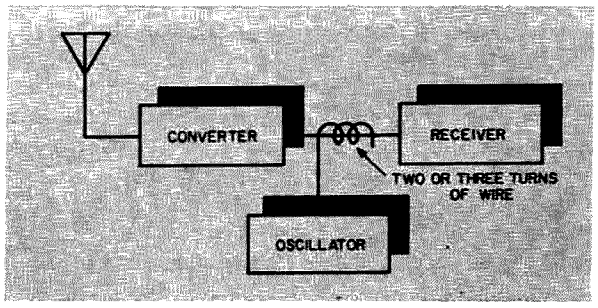
Now, if you haven't left me to plug in the soldering iron, I'll say what you know I'm going to.

The simple, easy, etc. way is this. Make a simple osc. (one tube or a couple of transistors) with a variable injection level control for the conversion freq. Connect as per the block diagram, and presto! SSB is suddenly AM. Merely tune the osc. slightly on a good, average SB signal, touch up the injection level, and there you are!

I won't give any const. details, as there are scores of circuits for an osc. of this type around.

That's it, go to it, and maybe you, too, can become a SB addict.

. . . WøWUZ



GO FIRST CLASS ON SIX

The LW-51 Deluxe

$57.50



Features:

- 50 watts input, fully neutralized
- Uses inexpensive 8 mc xtals or VFO
- Plate modulated for efficiency and punch
- Input for crystal or carbon microphone
- TVI-proofed even in Channel 2 fringe area
- In kit form to cut costs
- All hard parts mounted (over 100)
- 6 or 12 volt filament
- Speech clipping & limiting for max modulation

Order Direct:

LW-51 Deluxe kit, less tubes & xtal	$57.50
LW-51 Deluxe kit, with tubes & any xtal.	69.50
LW-51 Deluxe kit, wired & tested	84.50
Ship weight 7 lbs.: 77c East Coast; $1.59 Western	
LW-72 AC Power Supply for LW51, wired	49.95
LW-61 VHF Converters	18.50
LW-80 Pre-Amplifiers	12.50

LW ELECTRONIC LABORATORY

ROUTE 2 JACKSON, MICHIGAN

(RTTY from page 27)

CEIVER INPUT." Plug the 'Red' plug of the model 15 Teletype machine into the "SELECTOR MAGNET" jack. Connect the keyboard to "KEYBOARD INPUT" and connect "AFSK OUTPUT" to the two meter transmitter modulator. Set function switch to "FIL" and tune receiver for proper X presentation on scope, from RTTY signal. Set function switch to "REC" and adjust loop current for 30 milliamperes. (Model 15 machine). Machine should print normal copy; if not, switch polarity. To send and make a local copy, switch function to "LOCAL LOOP." Receiver output is then automatically disconnected and AFSK output is fed to the transmitter. The AFSK signal is also sent through the terminal unit and drives the printer.

My T-U has been in operation on 40 meters FSK and 2 meters AFSK for several months. No problems in TU equipment operation or malfunction have occurred. My only problem has been dirty contact points on the keyboard causing errors in copy. A good cleanup using lacquer thinner cured this problem. I would also like to add that if the reader decides to build such a unit as this, do not be worried when you come to some problems you have not expected. Just contact one of your local RTTY'ers for the answer, as he will probably have had the same or similar problem. This is because "RTTY'ers build their own."

. . . WøRQF

Sideband the Easy Way

or tricks with the 10A

Herbert S. Brier W9EGQ
385 Johnson Street
Gary 3, Indiana

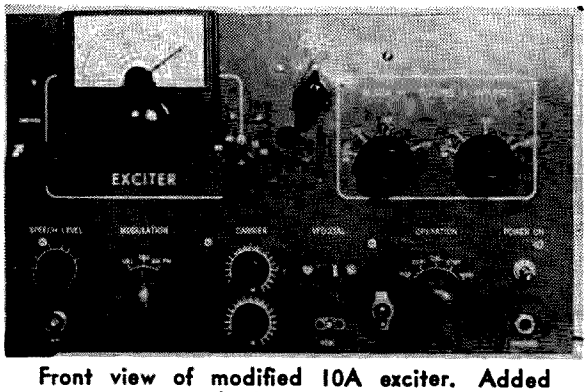
IF you would like to give SSB a whirl and have a good AM transmitter which you don't want to discard, the whirl can be a lot easier and less expensive than you may think. Central Electronics 10A and 10B SSB generators are naturals for converting transmitters like the E. F. Johnson Viking "Valiant," "500," or the Globe "Champ," or "King," etc., to SSB operation without affecting their AM capabilities in the least. All you do is feed the output of the SSB generator into the SSB input jack on the transmitter.

The 10A shown on these pages is currently driving a Johnson Valiant; it has also driven a variety of tetrodes in class AB1 and class AB2 amplifier service on all ham bands from 3.5 to 29.7 mc at power levels up to the proverbial "cool KW."

Of course, there is nothing new in the information that most modern AM transmitters can be used on SSB with an external SSB exciter. The trouble has been that suitable, low-power SSB generators have cost almost as much as a complete 150-watt SSB transmitter. But now many dealers' shelves are loaded with C. E. 10A's and 10B's traded in on new gear. Many of the older SSB operators also have such units stashed away in their shacks. With a little dickering, these units can be picked up at very reasonable prices.

"But," I hear you protest, "these exciters use a pretty old circuit. Besides, I don't like the idea of tying my bandswitching transmitter to an exciter with plug-in coils."

Omit the final amplifier stage and some of the frills on many of the phasing-type SSB exciter/transmitter units around today, and what is left is basically the circuit of the 10A and 10B. Incidentally, there are only minor differences between the 10A and 10B. It is because many other hams feel the same way as you do about plug-in coils that 10A's and 10B's are available so reasonably today.



Front view of modified 10A exciter. Added controls discussed in text.

It is a simple matter to add bandswitching to these units and modernize them in other ways. No true ham ever follows modification instructions exactly, so the following discussion is in general terms. The pictures and diagrams should clear up any doubtful points.

If you have a choice when picking up a 10A or 10B, take the "B," but don't pay too much of a premium for one. But do get one with a plug-in QT-1 "anti-trip" unit. The QT-1 prevents signals from your loudspeaker from tripping the VOX circuit and putting your transmitter on the air. Also, try to get a full set of plug-in coils. However, you can replace any missing coils from the data in our coil table.

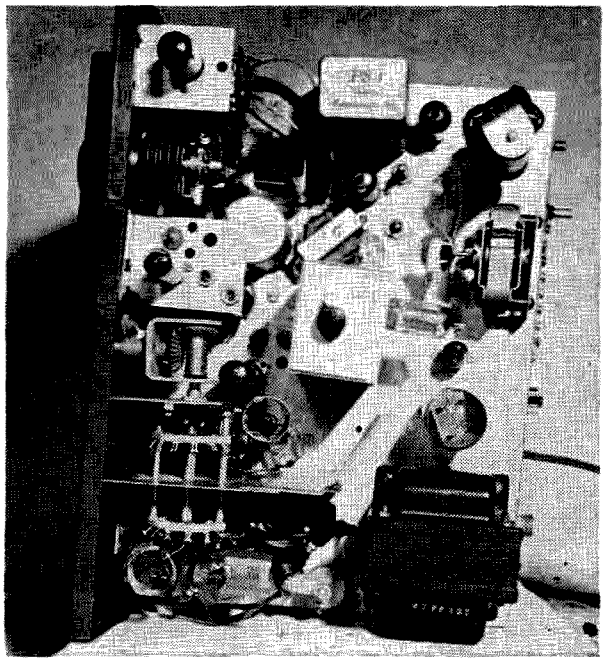
Bandswitching

Besides the coils, you will require a 2-section, 2-pole-per section, 5-position, rotary switch and a right angle drive (National RAD or equivalent) to install bandswitching. The switch may be a standard 3-section switch such as the Centralab 2023 with the center section removed, or it may be assembled from Centralab Switchkit components—2 PA-3 switch wafers and a 301 shaft and index assembly.

Replace the metal partition between the 6BA7 and 6AG7 stages in the exciter with a new one, as shown in the photos, to shield the complete set of mixer and amplifier coils from each other. Assemble the switch with one wafer on either side of the partition. After removing the coil sockets, mount the switch to the front panel with a metal bracket. Then, rewire the circuits as shown in Fig. 1.

The amplifier coils are removed from the plug-in forms and connected to S2 without modification. Refer to the coil chart for the number of turns on the revamped mixer coils. A single 20,000-ohm resistor salvaged from one of the mixer coil forms is connected across the mixer tuning capacitor for circuit "swamping." In the amplifier circuit, however, the original resistors from the plug-in coils are connected across the coils individually as required.

In operation, the exciter works exactly the same as before bandswitching was installed, except, of course, for the added convenience in switching bands.



Top view gives bird's eye view of added bandswitch, VFO and fan.

A Built-In VFO for the 10A

The converted BC-457 and 458 "Commandset" transmitters usually used as VFO's with the 10A's and 10B's work fine, but they are so big! There is room for a VFO inside the 10A cabinet. Refer to Fig. 2 and the pictures for details. By ganging S3 with the main bandswitch—which I didn't—you can eliminate a panel control. Also, resistors R2 and R3 in Fig. 2 replace the potentiometer marked "driver" to the left of the VFO dial in the front-view picture. The potentiometer turned out to be unnecessary.

By mounting the VFO tuning capacitor on the panel and the coil L1 and padding capacitor C2 directly on it, any flexing of the panel causes the combination to move as a unit. Consequently, the mechanical stability of the unit is surprisingly good. Mount the variable capacitor to place the top of the Millen 10039 dial level with the top of the panel. The 6U8A tube socket and associated components are mounted on an aluminum bracket on one side of the tuning capacitor. A similar bracket on the other side of the capacitor accommodates the OB2 and the plate coils.

The triode section of the 6U8A is the oscillator and tunes from 4750 kc. to 5440 kc. Its tetrode section multiplies the fundamental frequencies to the proper values to mix with the 9000-kc. SSB signal in the 6BA7 mixer tube to produce output on the various ham bands. I adjusted the oscillator frequency range by varying the inductance of L1 but reducing the capacitance of capacitor C2 to 360 uuf. and adding a 7-35 uuf. ceramic trimmer across the coil might make precise fre-

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T-R SWITCH

...with selectable bandswitching

This compact electronic T-R switch (4¾" x 4" x 4½") does a big job in automatic break-in operation on CW-SSB-AM-DSB. Bandswitch covers 80 through 10 meter bands. Integral power supply. For commercial applications, it will handle more than 1KW AM phone and up to 5KW SSB. "Fail-safe" design automatically keeps transmitter connected to antenna when unit is not energized. Matches 52-75 ohm coaxial lines.

This is the switch you've been looking for. See it at your local dealer, or write the factory direct.

PRICE $60.00

Barker & Williamson, Inc.

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NEW SURPLUS

R-267/ARR-27 RCVR. tunable approx. 450-510 mcs contains 28 tubes, blower, coax relay, 2 gear-head motors, etc. BRAND NEW IN DOUBLE SEALED CARTONS. Shipping wt. approx. 50 lbs. SPECIAL $24.50

KY-42/ARR-27 DECODER contains 43 tubes new $29.50
BIRD MOD. 74 coax switch 6 posn. brand new 22.50
ELEC COAX SW. spdt BNC connectors rfne 24 vdc 9.50
OHMITE TAP SW. 12 posn. mod 212-12 brand new 3.00
MOBILE toggle sw. SPST 175 Amps 30 VDC new 3.50
PL-259-or M-359 Coax connectors.....3 for 1.00
2 Mfd 3000 volt oil condenser.....new 5.00
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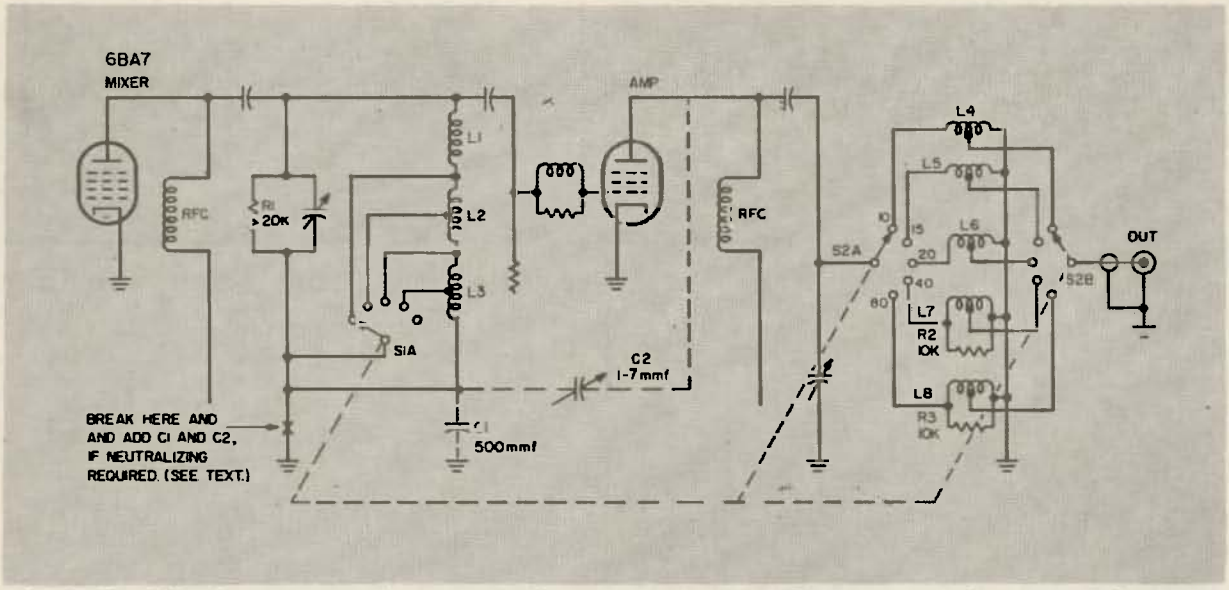


Fig. 1. 10A/10B mixer and amplifier tank circuits modified for bandswitching. Neutralizing circuit in dashed lines required only if 6AG7 amplifier is replaced with a 6146.

quency adjustment a trifle easier.

On 80 meters, the VFO tunes from 5000 to 5500 kc., and on 20 meters it tunes from 5000 to 5350 kc. On these bands, the tetrode section of the 6U8A acts as an untuned coupling stage. On 40 meters, the oscillator range is 5334 kc. to 5434 kc. tripled to 16,000 kc. to 16,300 kc. in the output section of the tube. On 15 meters, the oscillator tunes 5000 kc. to 5075 kc., multiplied six times to 30,000 kc. to 30,450 kc. Finally on 10 meters, the oscillator tunes from 4750 kc. to 5175 kc., multiplied four times to 19,000 kc. to 20,700 kc.

The 6U8A output coils are resonated to the desired frequencies by the circuit capacitances and the capacitance of the 14" length of RG-58/U coaxial cable between the 6U8A and the 6BA7 mixer tube. The coil slugs are peaked for maximum exciter output in the center of the most-used segment of each ham band.

Opening the hinged lid of the exciter causes the VFO frequency to vary somewhat. To foil my humorous ham friends who liked to swing the lid back and forth while I tried to raise a "rare one," I drilled and tapped two holes for 6-32 screws along the front edge of the lid and screwed it down.

Installing a Blower

With the VFO inside the 10A, it took approximately a half hour to settle down from a cold start, which was not too surprising, as the cabinet got almost too hot to touch after a period of operation. A cooling fan seemed to be the answer. A Barber-Coleman tube-cooling fan was installed in the position shown to pull in cooling air through the ventilating louvres in the back of the cabinet. This cabinet doesn't have ventilating louvres on the sides; there-

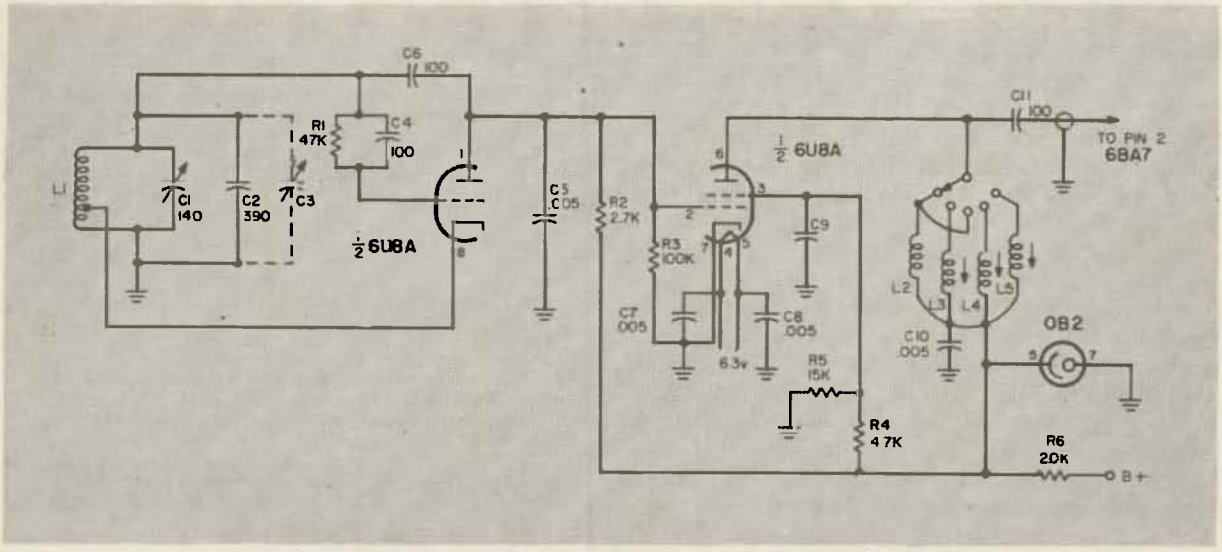
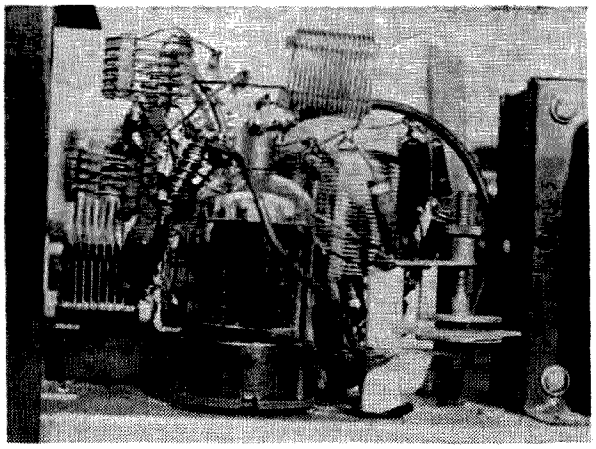


Fig. 2. Diagram for VFO and frequency multiplier for SSB exciter.

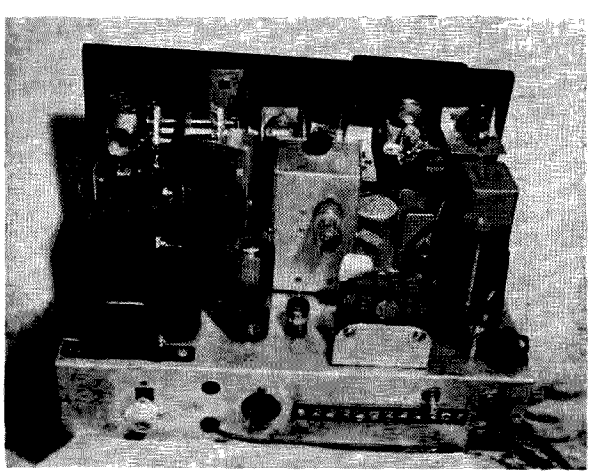


End view showing how amplifier coils grouped around amplifier tube and bandswitch. 20-meter coil hidden behind the tube. See text for more details. (That's why it was written.)

fore, I drilled 20⅜" holes in the side of the cabinet near the output tube. These steps cut the VFO warm-up time in half. They also reduced the temperature of the case at least 15 degrees. Although not strictly necessary, adding the blower was a worthwhile improvement. Incidentally, the dual filter capacitor displaced by the blower was replaced by individual cartridge-type capacitors mounted under the chassis.

Installing a 6146

When I used the exciter to drive a plate-modulated amplifier, the 6AG7 output tube got very hot during extended transmissions. Consequently, I replaced the 6AG7 with a 6146, obtaining its screen voltage from the OB2 in the VFO circuit. The 6146 works fine but not a bit better than the 6AG7 did. To discourage you from making this modification, it was necessary to neutralize the 6146 to keep it from oscillating. This, in turn, required changing the mixer tuning capacitor to one that could be insulated from the chassis, in order to obtain the necessary out-of-phase neutralizing voltage, as shown by dashed lines in Figure 1.



Rear view of exciter.

Just for the heck of it, I changed the amplifier tuning capacitor at the same time. This was a waste of time, too.

More Changes

To narrow the emitted signal a war-surplus, audio low-pass filter similar to the Stancor C-2341 with a cut-off frequency of 3000 cycles was installed between the plate of the audio driver tube and the primary of audio transformer T1. If you can pick up a similar filter at a reasonable price, it is well worth installing. Lacking one, connecting 0.001-uf. capacitors from pins 1 and 6 of the 12AX7 speech tube to ground will sharpen up the signal appreciably.

Finally, the VOX relay did not hold in quite long enough between words to suit me. Rather than learning to say "a-a-a-a-h" between sentences to keep the VOX relay closed, I connected an additional 0.5-uf capacitor from pin 1 of the 6AL5 VOX rectifier tube to ground. This increased the relay hold-in time just enough to suit me.

. . . W9EGQ

Added or Modified Parts for Figure 1

C1—500 mmfd mica.
C2—2-7 mmfd neutralizing capacitor.
L1 to L8—See coil table.
RFC1, 2—1-mh, r.f. chokes.
R1—20,000 ohms, 1 watt.
R2, 3—each 2 4700-ohm, 2-watt resistors in series.

Parts List for Figure 2

C1—140-mmfd midget variable. (Bud 1856 or equivalent.)
C2—390-mmfd silver mica, or 360 mmfd, plus C3-7-35 mmfd ceramic trimmer. (See text.)
C4, 5, 11—100-mmfd mica capacitors.
C6, 7, 8, 9, 10—0.005-mfd. 600-volt, ceramic capacitors.
L1—10 turns, 1" dia., ¾" long, tapped 3rd turn from ground end. (Part of B&W 3015 miniductor coil.)
L2—50-uh. r.f. choke.
R1—47,000 ohms, 1 watt.
R2—2700 ohms, 1 watt.
R3—100,000 ohms, 1 watt.
R4—4700 ohms, 2 watts.
R5—15,000 ohms, 2 watts.
R6—20,000 ohms, 10 watts.
L3—11 turns, #24 enamelled wire, ½" long.
L4—6 turns, #24 enamelled wire, ½" long.
L5—9 turns, #24 enamelled wire, ½" long.
Wound on ⅜" dia. iron slug-tuned coil forms. (National XR-50 or equivalent.)

Coil Table for Figure 1

L1—3 turns, 1" dia., ⅜" long. (B&W 3014 miniductor.)
L2—6 turns, 1" dia., ⅜" long, tapped 2 turns from top. (B&W 3015.)
L3—28 turns, 1" dia., 1¾" long, tapped 6 turns from top. (B&W 3015.)
L4—4 turns, 1" dia., ½" long, tapped ½ turn from ground end. (B&W 3014.)
L5—6 turns, 1" dia., ¾" long, tapped ¾ turn from ground end. (B&W 3014.)
L6—9 turns, 1" dia., 1 ⅛" long, tapped 1 turn from ground end. (B&W 3014.)
L7—15 turns, 1" dia., 1" long, tapped 2 turns from ground end. (B&W 3015.)
L8—26 turns, 1" dia., 1⅝" long, tapped 4 turns from ground end. (B&W 3015.)

The BC221 as an Accurate Audio Generator

V. A. Jupe WØOKH
Phillipsburg, Kansas

MANY techniques in our hobby indicate the need for an audio source of precisely known frequency. There are many of the BC221 Frequency Meters in amateur stations. By using the methods shown in this article, you will have a frequency accurate source for checking audio frequencies, aligning filters in Teletype TU's, and checking FSK deviation.

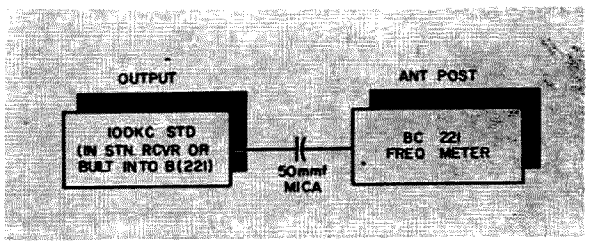
By adding a 100 kc standard oscillator within the case of the frequency meter and operating it from the internal power supply or by bringing a lead from the 100 kc standard in the station receiver to the antenna post of the BC221, you will have a beat-frequency audio standard equal in accuracy to the meter calibration.

The 100 kc standard and the internal 1000 kc standard are zero beat with WWV to establish primary accuracy. The second harmonic of the 100 kc standard is beat against the 200 kc VFO of the BC221 to produce audio frequency output from the phone jack on the meter.

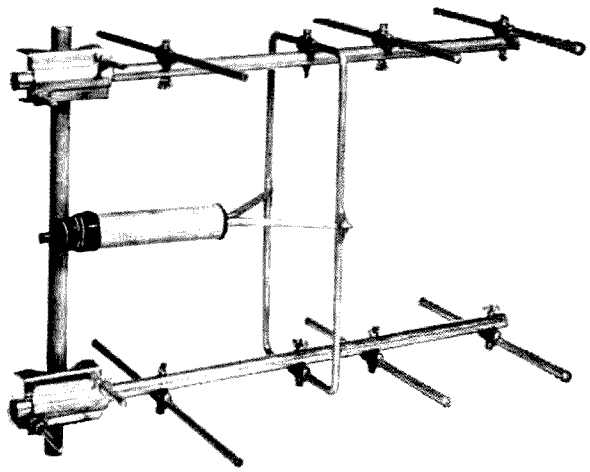
Full page linear graphs covering 600 cycle steps should be plotted starting at the *200 kc check point* in the calibration book. There will be approximately 22 full dial divisions per 600 cycle step. The writer drew graphs to a little over 3000 cycles which covered most used frequencies. The calibration should cover the 200 to 203 kc range in the book to obtain easily read graphs. Mark the 60, 440, and 600 cycle points for later use in verifying the accuracy of your calibration.

After completing graphs, the meter is placed in use in the following manner:

1. Be sure the 100 kc standard plate voltage is *off*.
2. Zero the 1000 kc standard against WWV.
2. Turn 221 to "Operate" on a frequency at least 10 kc away from the 200 kc check point. Turn *on* the 100 kc standard and zero with WWV.



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4. With the 100 kc standard ON and BC221 on "Operate" (assuming that you have calibrated 221 VFO at the 200 kc checkpoint), you should be able to set 221 to the audio frequency desired by reference to your graphs and hear this tone in the headphones connected to phone jack on the meter.

The 1000 kc internal standard and 2000 kc VFO range combination is not used for audio purposes because of crowded calibration characteristics and poor stability. I have the 100 kc standard built into the battery compartment of my meter with the plate switch coming out of the compartment into the headphone storage compartment. The 100 kc standard should be turned *off* when audio measurements are not being made.

A double-ended male patch cord can be used to take the audio output from the BC221 to a jack on your 'scope or receiver output for audio mixing for measurements. If it is desired to measure the FSK from an exciter, patch meter audio in parallel with your receiver audio output jack. Turn on exciter, zero receiver BFO on edge of at least a 3 kc passband, and zero the receiver on your MARK frequency. Then, with "BC221" set up for 850 cycle output, shift exciter to SPACE frequency and adjust shift until zero beat is obtained against the 850 cycle tone coming from BC221. A 'scope could be used as an indicator if you don't trust your ears.

A patch cord terminated in a coupling capacitor can be used to feed audio TU's for filter alignment.

The waveform of the audio output from my BC221 is not satisfactory for use in aligning SSB phasing exciters; however, by having this accurate frequency indicating source available, I can be sure that I have my af generator set to the frequency needed. The project has been well worth the small amount of time and cash invested. . . . WϕOKH

Which Way is Up?

Roy A. McCarthy K6EAW
737 W. Maxzim Avenue
Fullerton, California

GETTING acquainted with new types of circuit elements is more interesting if they are used in such a way as to allow you to baffle, mystify or downright confuse your friends. The tiny thermistor beads, although in use since WW2, are relatively new in the sense that up until recently the cost was rather a bit high. This simple circuit will help get a fair knowledge of their peculiarities. It has never failed yet to attract and hold the interest of even the most casual observers. As a "Gravity Detector" it runs a close second to the plumb bob or the Newtonian apple.

To demonstrate the device, simply move it from side to side, back and forth and up and down. Regardless of the position it is held in output is obtained only when the motion contains a vertical component. The phase of the output signal is dependent on whether the vertical motion is up or down.

The complete circuit is shown in Fig. 1. The load resistor, R2, is selected to set the operating point on the negative resistance slope of the thermistor's characteristic curve. Typical characteristics for an 8 or 10,000 ohm bead are shown in Fig. 2. R1 is used to prevent applying an abrupt surge of current to the bead, since these take appreciable time to reach operating temperature.

The thermistor should be mounted in a small clear plastic case, using extreme care not to break the fragile leads, or lose the thing by sneezing when you open its container. Flexible leads connect to the rest of the circuit. All connections should be soldered, since if clip leads are used and one happened to come loose, the natural tendency is to clip it right back on. That can be disastrous.

Rather than tell your friends how it works, let them try to figure it out. The theory is that the thermistor bead has a little chimney of convection currents of heated air rising from it. Moving it sidewise lets the chimney follow the bead, since the air in the plastic box is trapped there. Moving it up or down changes the rate at which the heated air rises from the bead, modifying its temperature. Because all a thermistor does is change its resistance with temperature, a phase sensitive output signal is obtained, which is observed on a scope or voltmeter. . . . K6EAW

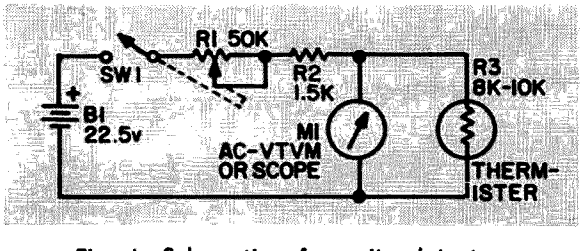


Fig. 1. Schematic of gravity detector.

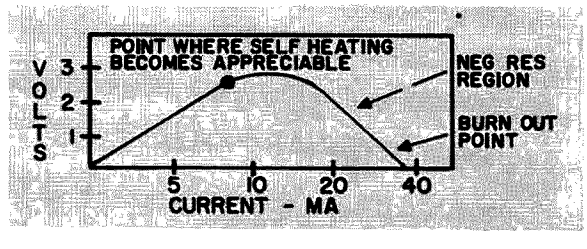


Fig. 2. Characteristic curve for a bead thermistor. Values may vary widely.

REF.: 73 *Magazine, Vol.* 1, *No.* 12, *September* 1961, *Article by Henry Cross, W1OOP, "Silicon Rectifiers"*

Silicon Rectifiers... Continued

Dear Wayne:

Congratulations on a job being done in an outstanding manner. The quality of the articles in 73 has been most gratifying.

As an Electronic Engineer I must point out that one ***very important*** design consideration was not pointed out in the article on "Silicon Rectifiers."

Unfortunately, semiconductor manufacturers do not control the reverse resistance of diodes to any great degree of uniformity. For example, the following chart, (Fig. 1), shows the reverse (back) resistance of 8 Motorola 1N1566 diodes. The following readings were taken with a Belleville-Hexem Corp. E-I-R Meter model 110-A.

Diode No.	Reverse (back) Resistance
D1	750×10^6 ohms
D2	280×10^6 ohms
D3	600×10^6 ohms
D4	480×10^6 ohms
D5	750×10^6 ohms
D6	20×10^6 ohms
D7	60×10^6 ohms
D8	500×10^6 ohms

Fig. 1. Reverse (back) resistance measurements of eight randomly picked Motorola 1N1566 silicon rectifiers.

Motorola lists the following characteristics for the 1N1566 diodes.

Voltage Ratings

Max inverse voltage 400 V

Max sine was RMS input voltage 283 V

Absolute Max Ratings

Average ½-wave rectified for current:

at 25°C ambient temp .....1.0 amps

at 100°C ambient temp .....0.5 amps

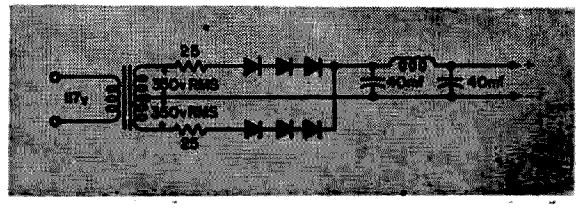
Peak ½ cycle for surge current:

60 cps, 25° ambient .....70 amps

Peak recurrent forward current:

60 cps, 25°C ambient.....10 amp

Now for the sake of an example let's consider the example 2B shown in the article by Mr. Cross.



The article stated that by using three 400 PIV diodes as shown in Fig. 2, the power supply could be expected to operate satisfactorily. If you build one as shown, and it works for any length of time, you're just plain lucky!

The reason that the circuit is not a good design will now be shown and the proper steps shown to make it into a reliable and rugged supply.

Let us examine the peak voltage that can occur across any one diode leg of the rectifier circuit.

Since the secondary of the transformer is center tapped the voltages appearing at the ends of the winding are 180° out of phase with respect to the C.T. The total peak voltage possible across the winding is the sum of peak voltages across each half of winding.

The peak value of a sine wave is expressed as: (V_{RMS}) $(\sqrt{2})$. Now since the halves of the secondary winding are (supposedly) identical then the total peak-to-peak voltage is twice the peak voltage of one-half the winding.

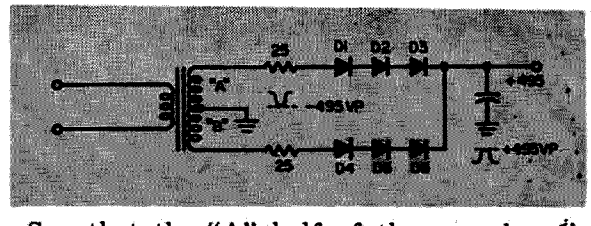
Therefore:

The max peak-to-peak voltage across the secondary winding equals

(2) $(\sqrt{2})$ (350) = 989.8 or approximately 990 volts

Now the input filter capacitor will charge (under no load) to one-half of the total peak-to-peak voltage across the secondary or +495 volts dc max.

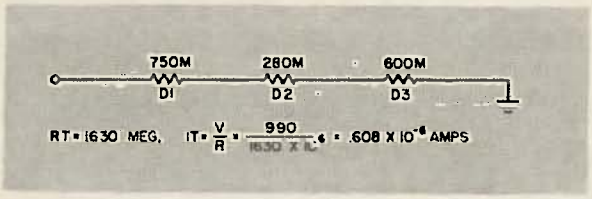
Now consider the following diagram.



Say that the "A" half of the secondary is the max. negative voltage it can go or, —495

V. Therefore, the total voltage across the "A" set of diodes is 495 V +495 V or 990 volts. Let us examine the voltage distribution in the reverse direction across the "A" series string of diodes.

Using the first 3 diodes shown in Fig. 1 the distribution is as follows:



The voltage across the diodes is therefore:

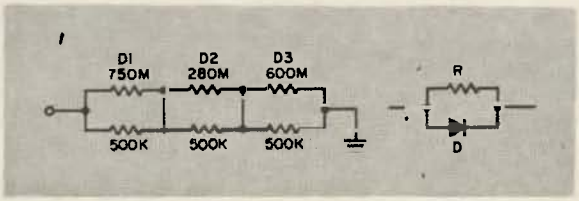
D_1 Volts = $(.608 \times 10^{-6})$ (750×10^3)
= 455 volts

D_2 Volts = $(.608 \times 10^{-6})$ (280×10^3)
= 170 volts

D_3 Volts = $(.608 \times 10^{-6})$ (600×10^3)
= 365 volts

The peak inverse rating of Diode 1 (400 PIV) has been exceeded. If the diode breaks down the resistance in the inverse direction will drop to around 100 ohms. This allows the peak inverse voltage ratings of the remaining diodes to be exceeded and POOF! a shorted secondary in the power transformer.

A simple and inexpensive method to keep this from happening is to parallel each diode with a resistor of approximately 220K to 500K ohms. (Fig. 4)



The effective resistance in the reverse direction is 3 (500K) ohm or 1.5 meg the total reverse current through the resistors is 990/ $1.5 \times 10^6 = 670$ μamps. Therefore, the total voltage across the resistor diode pair becomes 670×10^{-6} amp $\times$ .5 $\times 10^6$ ohms = 330 volts which is well under the maximum voltage of 400 allowable. The forward voltage drop is negligible as the .5 megohm resistors are in parallel with approximately 1 ohm. (Forward resistance of the diodes.)

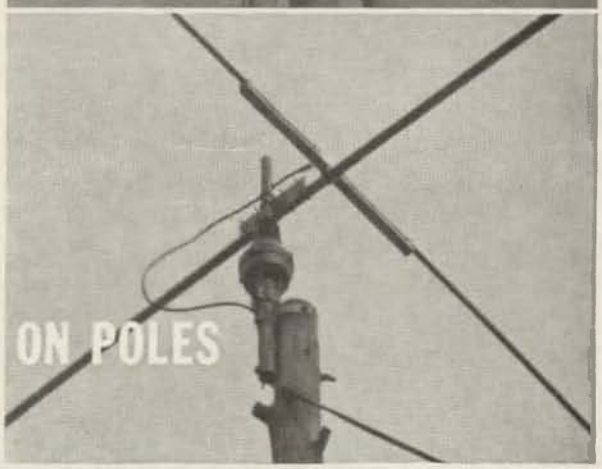
By going through the same kind of calculations for any given transformer and diode set one can arrive at the proper resistors to use to protect the diodes. As an added note of caution; be sure to check the wattage dissipated in the resistors and use the proper wattage resistors.

Since most hams don't own a meter which will measure 100's of megohms and even if they did, most supply houses wouldn't let him examine a bin full of diodes in the hope that he could find a matched set, it makes sense to add the bridging resistors to protect the diodes.

Charles C. Pierce WA6QFD







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Donald A. Smith W3UZN
Associate Editor

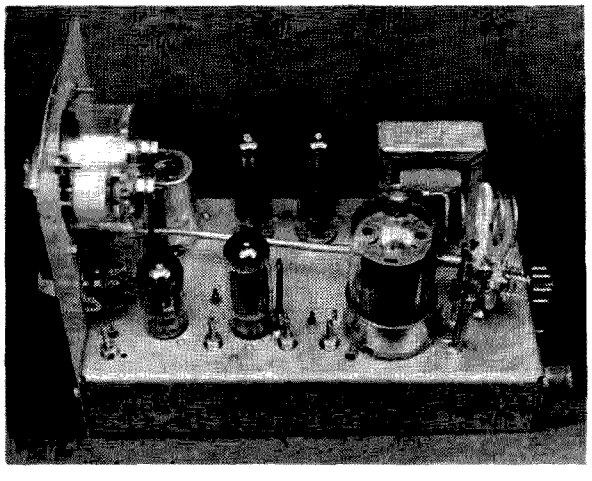
73 builds and Tests the LW-51 2M Xmitter

IT'S an old and well known fact that a small company must really have a good product if they are to remain in business with the large manufacturers as competitors. LW Labs, with their new LW-15 2 meter transmitter kit has, in my opinion, such a product. They are not by any means a new company, but they are a small one.

The little 2 meter rig has a lot to offer. The power input is 45 plus watts. The modulator, which is included on the same chassis, supplies more then an adequate amount of audio to fully *plate modulate* the final. Provisions are made for Hi Z or carbon mike input, by using a different mike plug. The rig uses standard FT-243 8 mc crystals and the final amplifier operates straight through! With a price tag of $59.95 for the rig less tubes, or $74.95 complete with tubes and crystal. A power supply with voltage regulation and a high and low power feature is $49.95 complete, wired and tested (model LW-72A).

Circuitry

The rig uses the triode half of a 6U8A in a Hartley oscillator circuit, with the plate of the oscillator tuned to 24mc (with 8 mc xtal). The pentode half of the same tube is used as a tripler to 72 mc and it drives a 7558 pentode. The 7558 doubles to 144 mc and is *inductively* coupled to the 6146 final, to reduce harmonic coupling. The final is provided with a good neutralization circuit. If you have built 2 meter rigs you know what a job it can be to neutralize a final amplifier at 144 mc! The final tank is link coupled (and adjustable) to the coax output jack. A variable capacitor is also provided to tune out the reactance in the line.

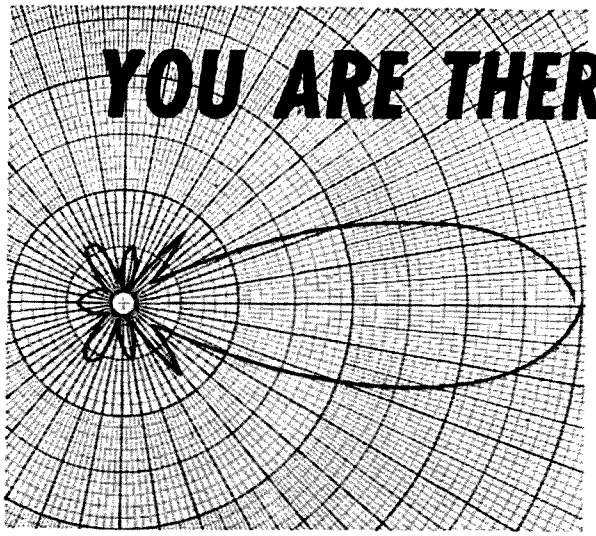


The modulator uses the pentode half of a 6U8a as a voltage amplifier, feeding the triode half of the same tube. The triode acts as a driver for the push-pull 6CZ5 output tubes. The driver is transformer coupled to the output tubes and they are transformer coupled to the plate and screen grid of the final. The amount of audio modulation is controlled by a pot in the control grid of the triode driver.

The filaments can be connected for 6 or 12 volts, depending on whether you're going to operate mobile in your 12 volt car or use the rig at the shack. The rig also has a diode detector circuit to give an indication of the relative power output and also give the modulation percentage on the front panel meter. The meter is switched to read oscillator, final grid, final plate, rf output and modulation percentage. The meter switch is located on the front panel, making selection a simple and convenient matter.

Construction

As soon as you unpack the kit you notice that there is a big difference between this and other kits. To begin with, the chassis is already mounted to the front panel. The bottom shield and cabinet is in place and it looks as if it is a wired model! All major parts are already mounted! The transformer, meter and



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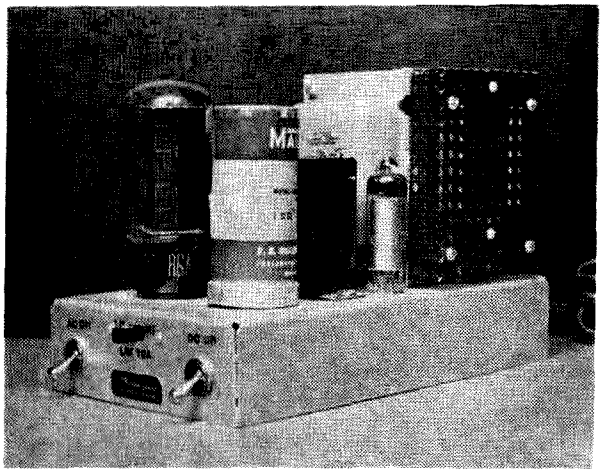
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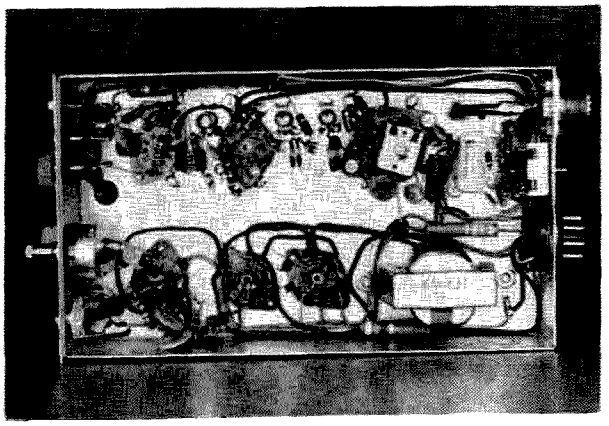
meter switch leads are already connected and the heavy soldering has already been done! Actually over 100 parts have already been mounted!

The kit builders work comes in wiring the filaments, resistors, capacitors, coils, etc. It's a real pleasure to wire the kit. The instructions and drawings are complete and are written in the way an Amateur would like to have them.

A unique method is used for double checking your wiring. LW has designed a chart which shows all of the connections. As you read across the chart, each connection which should be on the pin that is listed in the block. The builder without much in the way of building behind him will find this a very great help.

Complete alignment information is given by the manufacturer and the rig tuned up as per the script. Neutralization was a snap, unlike my experience with some of the 2 meter finals which I have built before. I was curious to see how the meter worked out on reading modulation percentage. To check it, the rig was connected to an oscillascope and the meter calibrated as per the instructions with the kit. I was surprised to find that actually the meter was very close. On sustained peaks, with the meter showing 100% modulation, the scope showed approximately 95%. The meter allows you to get maximum "talk-power" out of the rig without creating interference.





On the air checks showed the rig to be stable and very reliable. Two meter stations up to 100 miles away have been worked with excellent reports on signal strength, stability and modulation. TVI was checked carefully (in a fringe area) and found to be extremely low. With a TV antenna only 12 feet away almost no interference was noted on *any* TV channel, 2 through 13!

The rig has excellent quality parts and material furnished with it and very thorough instructions. The rig comes with a crystal of your choice, alignment tools and excellent protective packing. At $74.95, I think you will agree that it's a great buy for the VHF man.

.... W3UZN

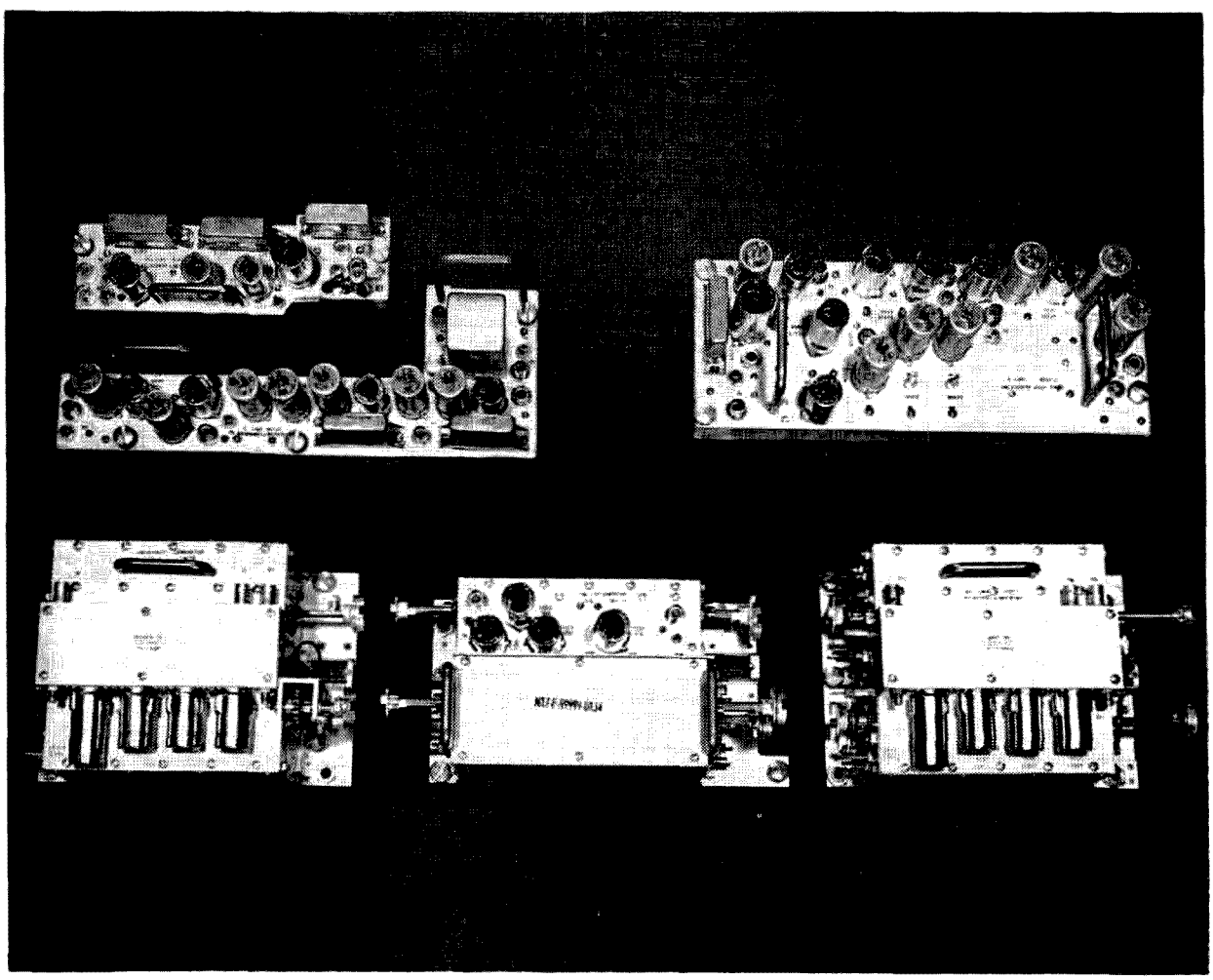
Surplus Frequency Synthesizer

Newly Released Components of AN/SRT-14 Transmitter Permit Economical Amateur Use of Frequency Synthesizer Techniques.

Roy E. Pafenberg
709 North Oakland Street
Arlington, Virginia

Photo Credit: Morgan S. Gassman, Jr.

SOME of the most appealing items of electronic surplus to reach the market in many a day are now available in sufficient quantities to be interesting. The equipment under discussion consists of a series of six replacement subassemblies from the Radio Transmitter, AN/SRT-14. The end equipment is a modern shipboard, 100 watt CW, FSK RTT and AM transmitter covering the frequency range of 300 kilocycles to 26 megacycles.



Available AN/SRT-14 sub-assemblies are shown above. They are, left to right and top to bottom, Frequency Converter Unit 11B, 1 mc Step Generator Unit 10, Frequency Converter Unit 9, 100 kc Step Generator Unit 8, Frequency Converter Unit 5 and Frequency Converter Unit 11A.

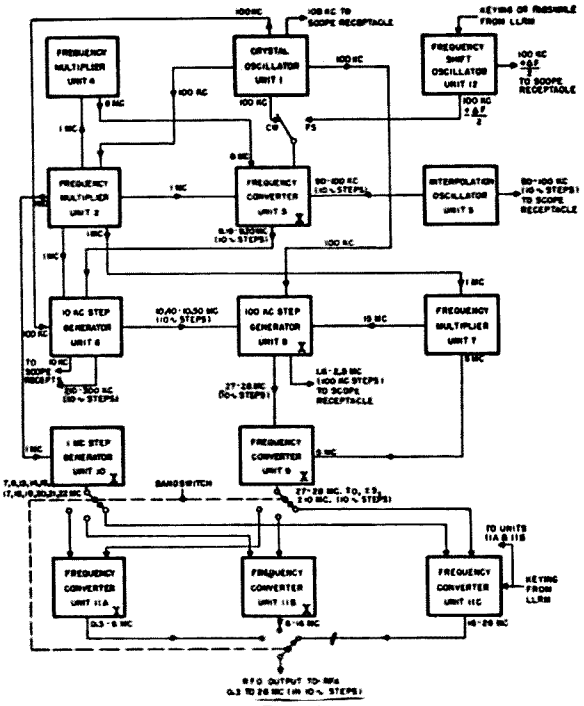


Fig. 1

To my knowledge this is the first item of frequency synthesizing transmitting equipment to reach the surplus market. The frequency synthesizer method of frequency control is becoming more and more popular, especially in high stability military and commercial transmitting equipment. This design concept employs a secondary frequency standard as a base frequency oscillator. While any frequency might be used for this standard, 100 or 1,000 kc is the logical choice. From this single frequency, by a series of manipulations involving multipliers, mixers, regenerative dividers and/or phase locked oscillators, the final air frequency is derived. This locked frequency control may be carried through to the air frequency or may be stopped at any point in the frequency generating chain and reliance placed on the stability and calibration of a limited tuning range, low frequency interpolation oscillator to "fill in the holes" in the spectrum. If this locked frequency control is carried through to the air frequency, the coverage will not be truly continuous. Highly stable output will be available only on the so called "detent" frequencies of the equipment. The separation of these discrete frequencies varies with the complexity of the equipment and may be 1,000, 100 or 10 cycles. There is nothing magic in these figures and any other logical interval may be used. The point is that, at some point in the design, operational flexibility must be sacrified to avoid undue complexity and cost.

The frequencies generated and used in the various conversions required to afford the wide frequency coverage of the AN/SRT-14 are numerous and the combinations vary for each of the bands covered. The following discussion has been simplified to the point that it does not describe the exact means used to arrive at any particular output frequency. However, this over-simplification leads to an easier understanding of the basic circuitry.

In the AN/SRT-14, the frequency standard is a 100 kc crystal oscillator, accurate to within 1.5 parts per million. From this highly stable source, three separate blocks of frequencies, spaced at 1 mc, 100 kc and 10 kc intervals are generated. Each of these frequencies is locked to and of the same order of stability as the 100 kc standard. By means of switched, selective circuits, the desired frequencies are chosen and combined in mixers to arrive at a frequency 90 kc lower than the desired air frequency. This frequency is mixed with the output of a highly stable oscillator, tunable from 90 to 100 kc. This oscillator is not synchronized with the equipment standard, but is of such an order of stability that the air frequency is known within 20 cycles. The interpolation oscillator is tuned by three decade switches which are used to change the frequency in increments of 1,000, 100 and 10 cycles.

Since all stages of the exciter are switch tuned, it becomes a relatively simple matter to gang the various assemblies and arrive at an exciter that is completely tuned by the setting of detented selector switches. Putting this exciter on any frequency is simply a matter of setting the basic frequency band and positioning the 1,000 kc, 100 kc, 10 kc, 1 kc, 100 cycle and 10 cycle selector switches so that the desired air frequency is read out on the decade calibrated scales.

The over-simplifications employed in the above discussion are apparent when the block diagram of the exciter, shown in Fig. 1, is studied. Signal path and derivation of the various frequencies for each frequency band are shown. While an exciter such as this is admittedly complex, the superior performance justifies use of the techniques employed. Those who desire to pursue the subject of frequency synthesis further are referred to the excellent treatment contained in Collins publication, "Fundamentals of Single Sideband." This book is available from Collins Radio Company, Technical Publications Department, Cedar Rapids, Iowa, at a cost of $5.00.

Of the 14 units shown in Fig. 1, 6 are available through surplus channels. These units are identified by an "X" in the lower right hand corner of the block. The photograph shows these 6 assemblies laid out in their approximate mechanical relationship. It is unfortunate that all of the assemblies are not available, but that is the luck of the surplus market. The units are available, in substantial quantities, from RITCO Electronics, Post Office Box 156, Annandale, Virginia. The assemblies are brand new, in sealed cartons, and are priced at between $5.00 and $10.00 each, less tubes. Mr.

Ritter, of RITCO, advises that a discount will be made if a complete set is purchased.

These units are a good buy, if only for parts. Unit 11 B, for example, has 40, $\frac{5}{8}$", stud mounted, slug turned coil forms and 43 coaxial, stud mounted, trimmer capacitors. All parts are military grade and suited to the compact construction employed. However, their primary application should be as originally designed, with such modifications as required to adapt them to amateur practice and provide all band coverage. Units which are not available are such that any constructing amateur can provide, at nominal cost, the required fill in units.

Preliminary work has been performed on all band, CW, AM and SSB exciter using these components arranged as shown in Figure 8. The un-numbered blocks represent circuit functions not available in the surplus units. These units are conventional and should pose no problems to the experienced constructor. Use of a crystal calibrator, kit or manufactured, is suggested for the 100 kc oscillator.

Despite a sincere effort on the part of the editor, schematic diagrams of the available units, Figures 2 through 7, are too large for inclusion in this article. These drawings are so detailed, showing frequency relationships, power requirements and connections, rf terminations and control identification, that they would not satisfactorily reduce to the publishers format. Therefore, these schematics, Chart I, a complete frequency plan of the proposed exciter and Fig. 9, a diagram of one of the missing units to serve as a guide in the design of the frequency multiplier and cathode follower stages, have been withdrawn. The writer has arranged these drawings to use a minimum of paper, had a reproducible master made and turned this over to RITCO Electronics. A yard square, white print containing the chart and drawings will be supplied, at no cost, with the purchase of a set of the units and individual units will be furnished with the appropriate schematic. For those who wish only the drawings, RITCO will supply these at the cost price of 75 cents.

The following discussion covers work, in progress or proposed, on this exciter. While not tested, except for the fact that the units perform identical functions in the AN/SRT-14 Transmitter, no difficulty is anticipated. Coil and capacitor data given is based on extrapolation of existing LC circuits in the equipment which use the same coil form and core. Be that as it may, good luck and a grid-dip meter will resolve all argument.

In line with this plan, work in Unit 5 is limited to alignment. The following procedure is designed for use with a 455 kc SSB generator. Once aligned for this mode of operation, CW or AM operation may be obtained by introduction of carrier. If the SSB generator is not available, the VFO frequency range may



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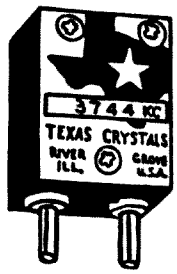
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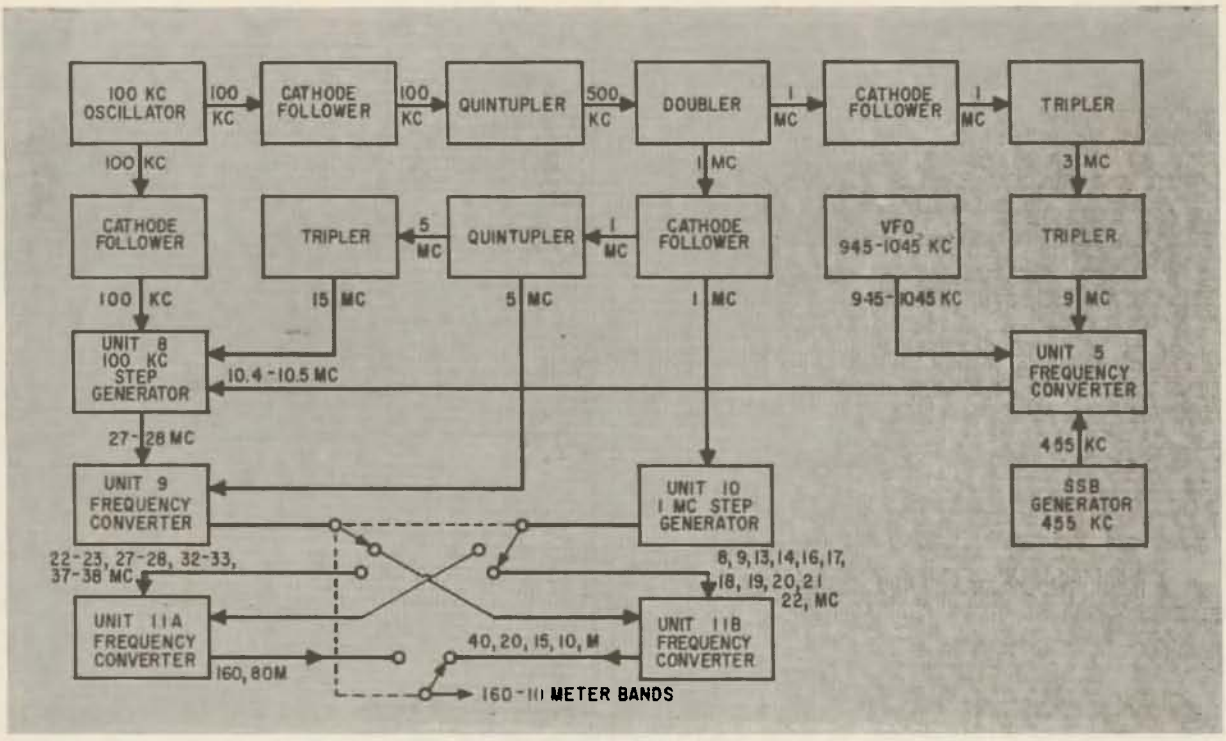


Fig. 8

be changed and it connected to another input. Connect a VFO covering the range of 945 to 1,045 kc to J-2152. Output should be about 1.2 volts into the 1,000 ohm load. Jacks J-2153 and J-2154 are not used in this arrangement. Apply power to the unit and connect a VTVM rf probe to pin 7 of V-2152. Adjust the primary and secondary slugs of Z-2151 and Z-2152 for uniform response over the VFO frequency range. It may be necessary to add a small capacitor across the transformer windings to resonate them to the desired frequencies. Conventional stagger tuned alignment techniques apply in this and the following steps.

Connect the SSB exciter to Jack, J-2155, and introduce carrier to produce about 1.2 volts across the 150 ohm input resistor. Move the VTVM probe to pin 1 of V-2153 and adjust the primary and secondary slugs of Z-2153, Z-2154 and Z-2157 for uniform response through the 1.4 to 1.5 mc range. This band is the sum of the VFO and SSB generator carrier frequencies. While improbable, it may be necessary to reduce the value of the capacitors shunting the transformer windings.

Apply the 9 mc input, at about 1.3 volts, to J-2151. Terminate J-2156 with a 51 ohm resistor and connect the VTVM to this point. Sweep the VFO through its range and adjust the primary and secondary slugs of Z-2155 and Z-215 to provide uniform output over the 10.4 to 10.5 mc band. Output should be about 1.3 volts. If SSB operation is not contemplated, change the frequency range of the VFO to 1.4 to 1.5 mc and connect to J-2153. Align as above, ignoring the adjustments of Z-2153, Z-2154 and Z-2157. The other input jacks are not used in this mode. Remove the terminating resistor and VTVM probe and Unit 5 is ready for inter-connection as shown in Figure 8.

To provide full amateur band coverage, one frequency is missing from the range of the Unit 10 harmonic generator. A 9 mc injection frequency is required for output on the 28-29 mc band. Since the 7 mc frequency is not used for amateur band coverage, these circuits are readjusted to 9 mc. The existing 7 mc coils, L-2526, L-2537, L-2548, L-2559 and L-2570 are adjustable over the range of 3.3-6 μh. Since the inductance required for these circuits at 9 mc is something on the order of 2.5 μh, turns must be removed. Removing about 7 of the existing 22 turns should be about right. Connect power, switch the band switch to position 0 and apply the 1 mc input at about 8.6 volts. Loosely couple the output of the unit to a receiver tuned to 9 mc. Adjust for maximum output and then peak, using an rf probe and VTVM.

Last of the modifications involves Unit 11B. Three of the unused 1 mc range positions must be altered to resonate in the 21-22, 28-29 and 29-30 mc bands. Positions 5, the former 15-16 mc range is selected for the 21.22 mc band. The 4 tuned circuits involved use .56-1.0 μh inductors, parallel with 91 mmfd capacitors to achieve resonance with about 32 mmfd additional capacity. Reducing the value of capacitors C-6, C-33, C-56 and C-83 to approximately 18 mmfd should enable alignment to the 21-22 mc band. Position 2, the former 12-13 mc range is selected for the 28-29 mc band and position 3, the former 13-14 mc range is selected for the 29-30 mc band. Inductors for both bands, L-3, L-4, L-13, L-14, L-27, L-28, L-37 and L-38, should be trimmed to 5 turns each.

The existing shunting capacitors should be removed. 27 mmfd capacitors should be installed in shunt with position 2 inductors and 24 mmfd capacitors installed in shunt with position 3 inductors.

Alignment of Unit 11B should be postponed until the completed exciter is available. Adjustment involves sweeping each of the three altered bands in 100 kc increments. Rock the 100 kc selector switch and maximum output should occur at the respective 100 kc switch position. If not, adjust the inductances appropriate to the band until this is true. Do NOT adjust the 100 kc step trimmer capacitors since this will destroy the correct alignment for the other bands. As a last resort, the capacitors shunting the inductors may have to be changed to obtain the proper LC ratio. If all goes well, the exciter should deliver an output of approximately 2 volts into a 50 ohm load on all bands.

The completed exciter should be connected and tested with the various units unmounted and accessible. RF connectors are the BNC type and 50 ohm cable should be used. Power connections to each of the 6 AN/SRT-14 units are made through identical Winchester Electronics, MRE-14P-G connectors. The receptacle to mate with this plug is Winchester Electronics part MRE-14S-G. A cable hood is available as part MRE-14H.

Mechanical design of this exciter has not been finalized. The proposed arrangement consists of a 10½" relay rack panel with a standard 12 x 17 x 3 inch aluminum chassis mounted at the bottom of the panel. A ⅛ x 17 x 10¼ inch aluminum plate will be attached to the rear of the chassis and the top of the plate braced to the front panel by ⅜ inch aluminum rods. The power supply, SSB exciter and the other fabricated circuitry will be contained on the chassis and the surplus units bolted to the front and back of the aluminum plate.

The switches in the surplus units will be actuated by Oak or Leadex rotary switch solenoids mounted directly to the external detent assemblies. These actuators are controlled by remote switches and operate on the "open circuit homing" principle so dear to the hearts of airborne military radio equipment designers. In this concept, the only front panel, frequency determining controls will be the linearly calibrated, 100 kc range VFO dial, the 1 mc or band selector switch and the 100 kc selector switch.

All in all, this is a very worth-while construction project. Performance should equal or exceed that of the best commercial amateur exciters and the cost negligible in comparison to that of manufactured equipment. In addition, the experience gained in the newer techniques of frequency generation will prove invaluable to any serious constructing amateur, particularly if he is engaged in allied commercial endeavor. . . . Pafenberg

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THE URC-4 is a fairly new item to the surplus market in limited number, however, it is known that MARS and CAP personnel have some of these in their possession. Description of the unit is as follows: It was originally operated on the two following frequencies of 121.5 and 243.0 megacycles. The complete set consists of the transceiver, battery, and connecting cable. Battery required is 135 volts B-Plus and 1.3 volts for filaments. The receiver is a superregen. The transmitter has three stages for 121.5 and a doubler stage for 243 mc.

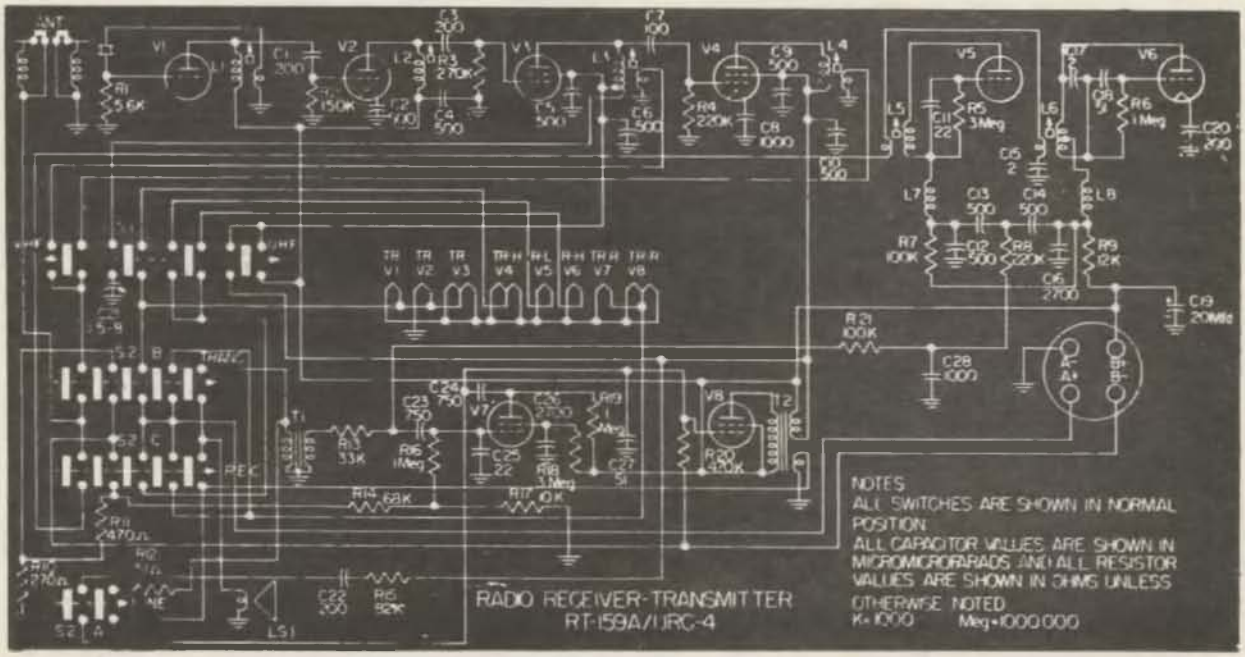
Receiver

The first item is to remove the cover which may be clipped on or held with screws. After you have the cover removed you will find in the set on the chassis three red screws. Loosen these screws all the way and carefully remove the set from the case. You will notice there are some wires connected to the case. It is not necessary to unsolder these wires, but you may do so. Now, referring to the schematic which is on the reverse side of the case cover, find coil L-5. Unsolder the wire from the plate of V-5 and carefully remove one turn and resolder to the plate pin of V-5. Remove tube V-6 which is on the underside of the chassis and save for spare. This tube could be left in and used to listen to a 220 mc signal if desired.

Transmitter

The transmitter conversion is about as simple as they come. The first thing to do is to decide what two meter frequency you desire to use. The International Crystal Company can supply crystals that will operate in this set for less than $5.00. The style of crystal is a HC6/U series with .050" pins. The crystal used operates at series resonance, in the 36 and 37 mc range for two meters. Remove the barrel type crystal if it still happens to be in the set and bend spring clip back and forth until it breaks off. I do not recommend drilling of the securing rivet as disastrous results could happen. Now solder a crystal socket for the above crystal to the two crystal contact posts on the chassis in a horizontal position. Remove tubes V-1, V-2, V-3, and V-4. Save Tube V-4 for spare. Remove the yellow plastic cover which protects the coils, there are two screws that secure it, just loosen and lift up.

Unsolder the wire that connects to the plate pin of V-1, this is the wire to coil L-1. Carefully remove three turns from this coil and resolder to the plate pin of tube V-1. Be careful not to get too much solder on the pin as it may run onto an adjoining pin. Coil L-2 is modified in the same manner with the removal of two turns. Coil L-3 gets one turn removed on the plate side of tube V-3 and is resoldered. Reinstall the plastic coil protector with the two screws. Insert tubes V-1, V-2, and V-3 in their sockets and make sure the red index marks on tubes match that of the tube socket. At this time it would be a good idea to check



the continuity of all slide wafer switches to make sure they are making good contact, also the antenna contact spring on the underside of the chassis. Now carefully install the chassis in the case and secure with the three red screws.

It should be brought up at this time that a battery supply must be decided upon. This we leave up to your ingenuity. Some may solder direct to the plug pins and others may want to convert to a Jones plug or other type of connections. Batteries used are two 67½ volt batt.; and a 1.3 volt filament batt. Connections are shown on the diagram. The two 67½ batt. are connected in series. We now modify the case cover lid to facilitate easier tuning of the transmitter. A ¼" hole is to be drilled in the lid so that coil L-1 may be tuned with the cover installed, this is due to the detuning of the oscillator by the capacitance of the lid. Do not install cover lid at this time as the initial tuning is accomplished with the cover off.

Tuning

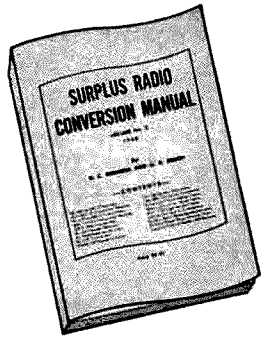
If you have access to a Gonset Communicator it will make tuning easier, otherwise you will need a VHF signal generator with modulation and a VHF sensitive frequency meter, or receiver. First let's go through the operating procedure on this set in case the instructions have been removed from the front. There is a large slide switch on the left side of the set, this should be in the VHF position. On the right side we have three buttons at the bottom of the set marked; receiver, transmit, and tone. These buttons have a lock which is a tab located at the lower part of the receiver buttons; to unlock pull tab down. Any button may be locked in the actuated position by holding the desired button in and at the same time pushing lock tab in. These buttons also have an adjustment for travel which is an Allen adjusting screw located in the end of the individual button. The disappearing dipole antenna is unlocked by moving the thumb lock slide and pulling carefully up on the plastic top until it is fully extended. Then take the antenna elements and extend them horizontally and lock into the clips. The tuning of the receiver is next, so get yourself a non-metallic screw driver. Tune the signal generator to the frequency you want the receiver to work on. With the battery supply hooked up press in the receiver button and tune slug in coil L-5 until maximum reception is heard. If the above instructions do not produce results check your work or use that spare tube. Also the button travel adjustment may be out of adjustment.

To tune the transmitter we need a frequency meter or a VHF receiver tuned to the output of the walkie-talkie. Press the transmit button in, tune slugs L-1, L-2, and L-3 for maximum output. There may be more than one place where oscillations may occur when tuning the slugs; use the strongest. Tune with a non-metallic screwdriver, and be careful with slugs as they will break very easily. If they do, remove and replace with a slug from coil L-4 or L-6. Now we install the case cover lid with the ¼" hole drilled for access to coil L-1. Press transmit button and peak up coil L-1 for maximum output. No doubt there will or can be various changes to this for use in the 220 mc band, but it is not too popular here and the output would be much less. Tests have been made up to one mile to my QTH which uses a Gonset two with 100% results both ways, however, this is not in a city with skyscrapers. But I do believe this is one of the best two meter walkie-talkies to hit the surplus market.

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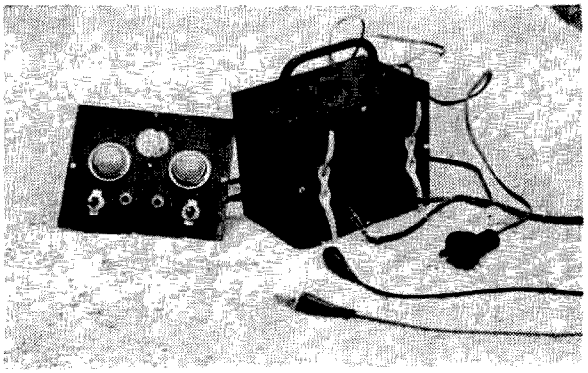
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Continuity and Power Transformer Checker

Power transformers with unmarked terminals or leads are always a challenge to the experimenter. The process of finding out which is the primary, the low-voltage secondary, and the high-voltage secondary has resulted in many a blown fuse or tripped circuit-breaker.

Most experimenters are familiar with the method of using a light bulb in series with the 117-volt line to check continuity. Many, however, use a carelessly-constructed device that in itself is a source of danger, not to mention blown fuses. After using just such an arrangement for a matter of over 25 years, the author decided it was high time to build a device that would accomplish the desired purpose with less element of danger to the operator.

First an analysis was made of the desired characteristics. It should be fused for safe operation and protection of house circuits. It should be self-checking, so that full trust may be given to its indications. It should be capable of being stored away compactly, with no dangling leads. And, finally, it should give not only a positive indication of circuit continuity but also a relative indication of circuit impedance.

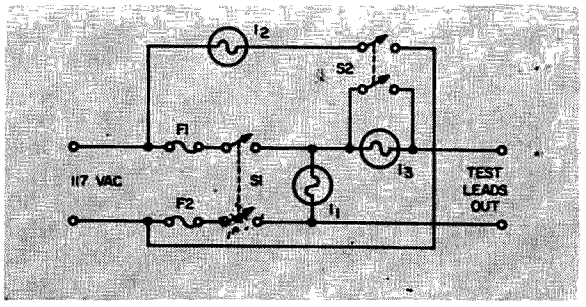
All of these operational requirements are met by the simple circuit shown in Fig. 1. No special skill is needed for any of its many uses or for its construction. A utility box 6" wide, 5" high, and 4" deep houses the few components. No chassis is used, but all parts are mounted upon the front panel, with the exception of the two line cleats attached to the rear face of the cabinet and used for storing the line cord and the output leads. Across the bottom of the panel, from left to right, are S1, F1, F2, and S2. Above them, again from left to right, are I1 and I2. At the top center is a 1-¼" hole through which I3 is viewed. The socket for I3 is mounted by means of tapped metal spacers. The spacing is adjusted so that I3 is flush against the panel. This ensures greatest visibility of its filament. Switch plates are used on S1 and S2 to indicate when the respective circuits are closed. If it is so desired, decals or other means may be used to label S1 as "Line Voltage" and S2 as "Full Voltage."

The circuit itself is so simple no wiring instructions are needed. All wiring is from a component terminal to a component terminal, with no tie points required.

Line cord input and test leads output are brought out through the rear panel and are protected by rubber grommets. A small carrying handle was mounted on top of the cabinet for added convenience.

A few simple precautions should be observed whenever the checker is used. The first steps are to separate the two output leads, making certain that their clips are not shorting and are not touching any grounded object including you. Snap on Switch S1, Lamp I1 should light up, indicating the unit is ready for the next step. Experimentally touch the two output lead clips together. Lamp I3 should light to full brilliancy. If there is too much light from the other bulbs it may be necessary to shield them from 13. Make careful mental note of the brilliancy of I3 with leads shorted for it will be used as a standard of comparison for further tests. Unshort the leads and snap off S1. This last is a very important step and should never be omitted, no matter how hurried the operator may be. Now you are ready to make tests with the checker.

If the experimenter is ambitious, he may want to add an isolating transformer to the input circuit. This has much merit as a safety measure but adds to the cost of construction, which otherwise can be kept to a very modest figure. Another possible refinement would be to mount permanently a female appliance socket on the panel and wire it across the output circuit. For a more objective indication of circuit impedance than relative lamp brillian-





Modifying the Lafayette HE-35

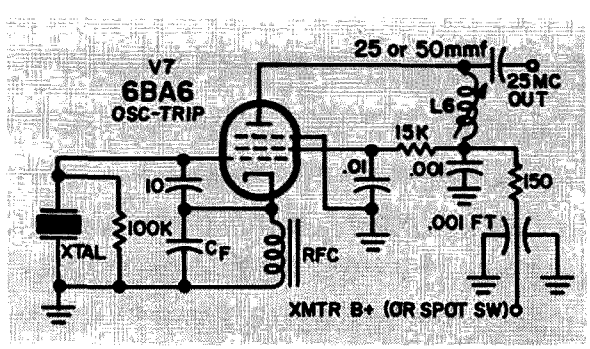
Larry Levy WA2INM

THE Lafayette HE-35 is a versatile 6 meter transceiver and is quite a bargain since it comes completely equipped and wired for only $57.50. As soon as it is unpacked it can be plugged in and put on the air, as it has a crystal and a microphone included. The only thing that is not included is an antenna. Incidentally, the rig will work with just a piece of hook-up wire, although a better antenna will naturally increase the range. In addition to this, the transceiver can be used in the car with a 6 or 12 volt mobile power supply. It is a very compact unit and can be set up almost anywhere.

Circuitwise, the transmitter has an overtone oscillator using one half of a 6CX8 driving the other half as a final. It is plate modulated by a 6V6, which is also the audio output for the receiver. The receiver is a single conversion superheterodyne with one stage of rf and one stage of *if*. It uses two tubes before the detector which perform all the functions of a superhet. The triode half of a 6EA8 is used as a mixer and the pentode half as an rf amplifier. The pentode half of a second 6EA8 is used as the *if* amplifier and the triode half as the oscillator. The set also includes a 6AL5 noise limiter. While it may appear that a receiver with so few tubes will be greatly lacking in sensitivity, I was amazed to find that it could receive weak signals quite well. Even from the car it is possible to receive stations running moderate power as much as 50 miles away. The overall performance of the transceiver is very good, and the quality of the modulation is excellent. As with any unit, there are a number of modifications which can be made that will improve the performance or the operating convenience. I made several modifications in the unit and the result was a transceiver that had all the features that I wanted. It should be noted that these modifications, with the exception of the first two, are independent of each other and any combination can be used, depending upon the preferences of each owner.

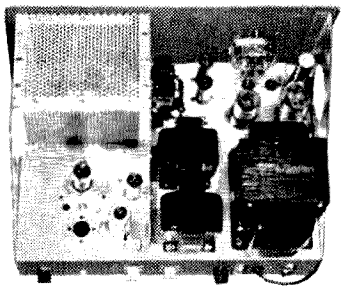
One disadvantage of the transceiver is its use of expensive overtone crystals. In Brooklyn it is almost impossible to remain on one frequency and have many QSO's completed without QRM. The problem is critical because there are so many HE-35's in use, all with the same frequency crystal. The cost of third overtone crystals makes it prohibitive to acquire a large collection of frequencies. A practical solution is to use 8 mc crystals, many of which are available surplus for less than a dollar. Another reason for the use of 8 mc crystals is the increased grid drive. Because of their construction, third overtone crystals cannot be used at high power levels and still have stability. For this reason the output of the overtone oscillator is limited and the grid drive on the final is low. This results in less efficiency than it is possible to get out of the stage. Although the drive is low, there is enough to have reasonably good modulation without splattering. With the increased drive available from the 8 mc crystals, the efficiency is greatly improved, as is the quality of the modulation.

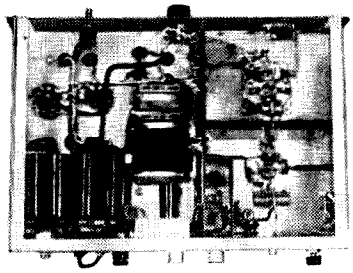
The use of 8 mc crystals requires an extra oscillator stage. I used a 6BA6 which has fairly low power requirements but has sufficient output when used as an oscillator-tripler to adequately drive the triode half of the 6CX8, now functioning as a doubler. When it is properly driven, the doubler will give more than sufficient drive for the final. A 6AU6 can be susbstituted for the 6BA6 if one is available. The oscillator is built on a piece of scrap aluminum about 2 X 2 inches. The assembly is bolted to the front panel. It is lo-



A

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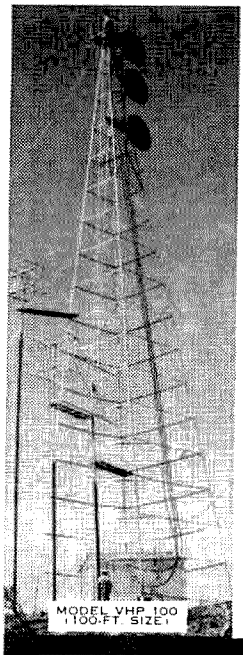
cated under the word "Band" at the top of the panel. It should be mounted far enough down so that the tube has a ¼ inch clearance from the top, about 2½ inches from the upper edge being sufficient.

The circuit is shown in "A." The value of "Cf" depends upon the inductance of "RFC." if "RFC" is 2½ mh, "Cf" should be about 150 mmfd. If the inductance of "RFC" is less, the value of "Cf" should be decreased proportionately. With a given inductance, the amount of feed-back depends on the ratio of "Cf" to the 10 mmfd condenser, so that decreasing the value of "Cf" increases the feed-back. If you desire to experiment, "Cf" can be a small ceramic trimmer adjusted so that a further decrease in capacitance will not result in an increase in output. Such adjustment is really unnecessary as the oscillator has sufficient output if a fixed condenser of approximately correct value is used. Coil L6 consists of 10 turns of #34 enameled wire, close wound on a Lafayette CO-310 coil form. Be sure that the coil is tuned to the correct frequency, as *any* harmonic of 8 mc will give grid drive. If the wrong one is chosen, either the drive will be low or the final will give no output. As an example, if the coil is tuned to 16 mc, the rig will work, although the drive will be less on the final because the triode will function as a tripler, with a resulting decrease in output. If the coil is tuned to 32 mc, the triode will not multiply, with no output from the final

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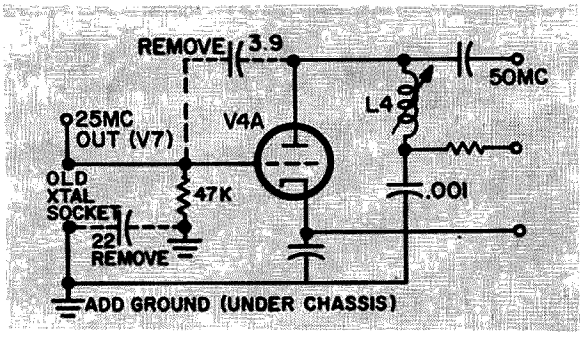


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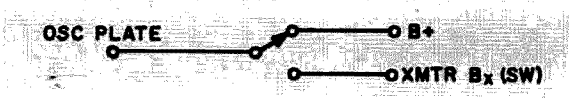
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B

as a result. It should be noted that the circuit given is an oscillator-tripler, not an overtone oscillator, and the tuning of the plate circuit or the harmonic selected has no effect on the oscillation, in contrast to overtone oscillators which are sensitive to the tuning of the plate circuit and only odd harmonics can be used. Diagram "B" shows how the new oscillator is connected into the circuit. The feed-back circuit from the original oscillator is removed by clipping the 3.9 mmfd condenser between the plate and grid of V4-A. The 22 mmfd feedback condenser is removed and the .001 condenser from the cold end of L4 is connected to the chassis with short leads. The wires are disconnected from the crystal socket. The output from V7 is connected directly to the grid of V4-A. The original crystal socket was removed and one that accepted FT-243 type crystals was substituted. As a matter of courtesy and convenience, I felt it necessary to add a spot switch. It is extremely simple to install and the results are worth while. The connections are shown in Diagram "F."

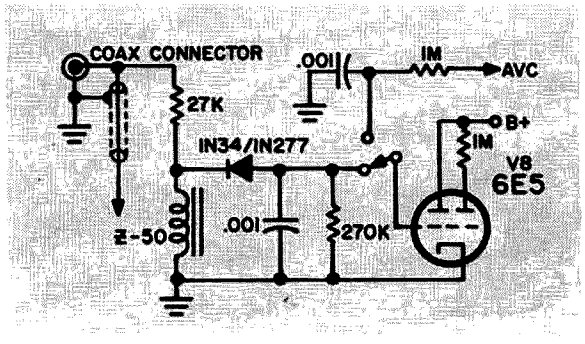


F

Inspection of the schematic revealed that when the unit is used on 12 volts the heaters are connected in a series parallel configuration. In order to maintain the balance in the heater circuit, it would be necessary to add a second tube that has the same heater current as the oscillator tube to the unit. A logical choice would be a tuning eye, which could be used to measure the strength of received signals as well as power output from the transmitter. An excellent choice for an eye tube is a 6E5 as it has the correct heater requirements and is quite sensitive. The tube is mounted on the front panel in an Amphenol tuning eye assembly. It is centered about 2 inches down from the top under the letter "i" in the word "Tranceiver." I mounted the assembly upside down because the rig is used most of the time with the operator looking down at the indicator and if it is mounted conventionally, it is necessary to tilt the transceiver as the shade obstructs the eye. As a tuning indicator for the receiver it is only necessary to connect the grid of the eye tube to the AVC through a 1 meg resistor. Better results can be obtained if it is connected on the detector side of the 2.2 meg isolating resistor. To use the eye tube to measure transmitter output, an *rf* detector is required to provide a few volts of negative bias. The grid of the eye tube is switched between the transmitter and receiver sections by the use of a miniature switch such as the Lafayette SW-76. Incidentally, this switch is a good choice for the spot switch and a pair of them can be used to preserve the appearance of the unit. The schematic for the eye and detector is shown in Diagram "E." To add the tubes into the circuit, connect the heater of V7 in parallel with V6 and connect the heater of V8 between pin 2 of V6 and ground.

One possible source of instability in the transmitter is the rf voltage present on the cathode of the final amplifier as well as on the leads to the transmit switch. The .01 bypass condensers used appear to be too inductive to act as an effective by-pass at 50 mc. I by-passed the cathodes with a .001 button condenser and connected the leads from the cathodes to the switch through a .001 feedthrough condenser, the cathodes being on one side of the feed-through and the leads to the switch on the other. This eliminated almost all of the rf voltage on the cathode.

One of the advantages of pi-network is the ability to load into almost any antenna whether it is properly matched or not. It was probably for this reason that it was included in the HE-35A. On the other hand, it has disadvantages of being less efficient than link coupling and more difficult to tune. Since I intended to use the unit with reasonably well matched antennas I felt that the increased efficiency of link coupling would be a worthwhile modification. The change also eliminated a slight tendency toward instability in the final. The final tank coil consists of 5 turns of #26 enameled wire close wound on a Lafayette CO-310 coil form. The link consists of 1 or 2 turns of insulated wire wound over the cold end of the coil. The coil was mounted in the hole originally occupied by the piston capacitor used for tuning the final plate. The

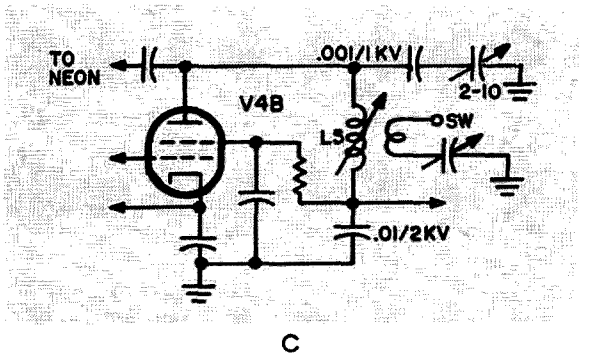


E

link is tuned by a 7-45 mmfd ceramic trimmer. If there is not enough capacity with the trimmer at maximum, a 50 mmfd ceramic disc can be added in parallel so that the tuning range is from 57-95 mmfd. It is usually not necessary as I found that maximum loading for most antennas is approximately 35 mmfd.

One inconvenience noticed in the operation is tuning the slug with a screwdriver inserted through a hole in the top. This can be frustrating, especially when trying to find the slot in the car at night. I decided to add a small tuning condenser on the front panel to eliminate this situation. A 2-10 mmfd miniature variable worked fine. It is connected through a .001 ceramic disc to the tank circuit to isolate it from the high dc and audio voltages present. In this manner a much smaller condenser can be used since it requires a lower break-down voltage rating and therefore smaller spacing between the plates. The condenser has enough range to tune the entire 6 meter band.

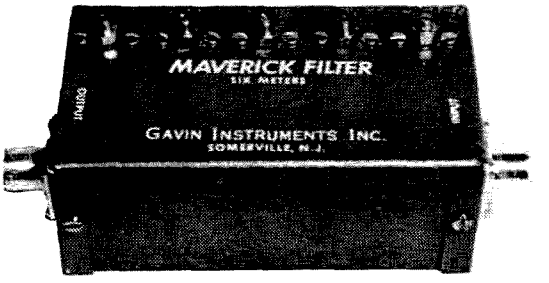
A front panel loading condenser is not really necessary, as the setting is not critical and usually does not have to be reset when changing frequency. One could be included if it is desired. The tuning condenser for this should be mounted so that the shortest leads possible are used. A good place is on the front panel between the rf indicator and the noise limiter control. The schematic for the changes are shown in Diagram "C."



C

The receiver section can be improved with a little rewiring and the changing of a few values. Although it has amazing sensitivity for the number of stages, its sensitivity can be increased further by the use of carefully controlled regeneration. The transceiver was very well designed from the viewpoint of stable operation. With the values originally used, there are no traces of regeneration. Almost any change in value that increased the gain introduced regeneration. If the amount of regeneration is carefully controlled, a stage is capable of a considerable increase in gain without any ill effects. Because the local activity is concentrated in the lower mc of the band, I decided to omit the 4700 ohm loading resistor across L1, which was originally used to broaden the response of the coil to 4 mc. This resulted in an increase in sensitivity. Re-

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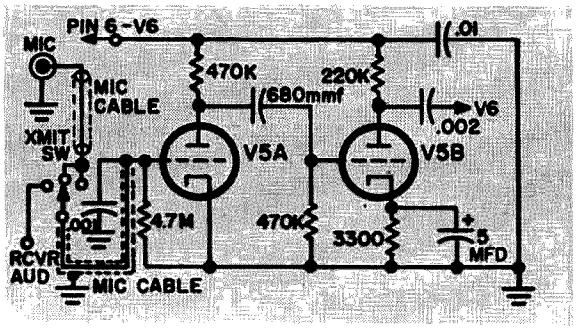
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moving the resistor across L2 resulted in instability, so it was left connected. The plate load of V1A was changed from 4700 ohms to 15K. Regeneration was added to the *if* stage by shorting pin 7 to ground and lowering the value of the plate supply resistor to 1K. This caused too much regeneration, so the amount of regeneration was reduced by shunting the primary of T2 with a 150K resistor. I also shunted the secondary of T1 with a 470K resistor. This achieved the desired amount of regeneration. The amount is controllable by the value of the shunt resistor across T2. Reducing the value of the resistor lowers regeneration. After repeaking the coils, the overall gain of the receiver was considerably higher.

Another modification that might be of interest involves the local oscillator. Since the local activity is concentrated in the first half mc of the band I did not see any need for having the receiver tune the full 4 mc. By changing the L to C ratio of the oscillator circuit I modified it to tune just 1 mc.

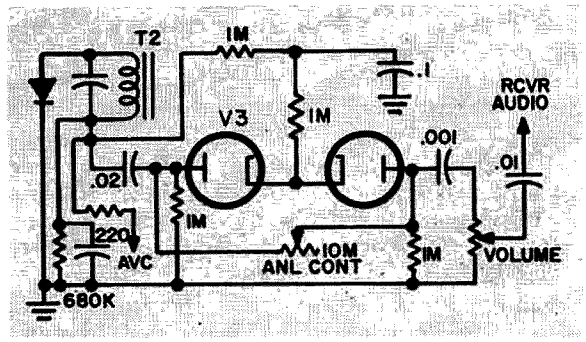


D

A slight drift was noticed on strong signals after the other changes were made in the *if*. This seemed to be a result of the voltage variation caused by the varying drop across a resistor as the plate current of the *if* tube changes with the AVC. The trouble was corrected by connecting the oscillator, through a decoupling resistor and filter, directly to the cathode of the rectifier. The changes are shown in "H."

When operating mobile, the need for additional audio is greatly increased since the rig has to compete with much higher background noise, the noise of the motor, wind, other traffic, etc. The noise limiter reduces the audio level further. It is difficult to receive a weak station under these conditions. One solution is to add another stage of audio amplification. A careful inspection of the schematic revealed that one-half of the 12AX7 wasn't doing anything in "receive." With a little rewiring of the switching circuits I added the extra stage of audio to the receiver. On "transmit," the stage still functions as a speech amplifier. The revised audio section is shown in "D."

I improved the noise limiter slightly so that it limits more effectively, though the original limiter was quite good. If it is desired, the modified limiter does not have to be variable



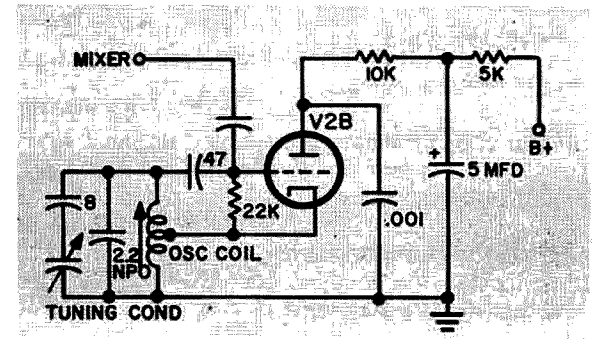
G

and the 10 meg limiter control could be replaced with a switch. I personally prefer the variable limiting feature, so I did not change mine. The modified circuit is shown in "G."

One attractive addition is a pair of indicator lights for transmit and receive. I used a pair of Lafayette MS-478 neon assemblies, one red and one yellow. The neons are connected through a 250K resistor to the switch B-plus contacts on the transmit switch. These pilots are very attractive and are a worth-while addition to almost any rig, especially because they are so inexpensive. Another convenience is a modulation indicator which is especially useful when operating at night. One can be made quite easily from an additional neon. It is connected through a .01 mfd 1000 v condenser to the modulated B plus lead of the modulation transformer. One side of the neon is grounded and the other goes to the condenser. While it will not indicate the exact percentage of modulation, it will indicate if there is modulation.

The modified transceiver has given excellent results both at home and in the car. At times the performance has been nothing short of amazing. An example of this is that I have worked several skip stations in excess of 1000 miles while driving in Brooklyn, using just a halo for an antenna. One of these contacts was made in heavy tarffic and almost completely surrounded by tall buildings. I received very good reports. The HE-35 is an excellent choice for those who are interested in participating in the fun of 6 meter operation or as a second rig for mobile or portable use.

. . . WA2INM



H

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Dress it up

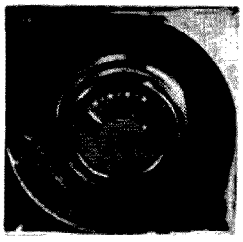


Photo Credit: Morgan S. Gassman, Jr.

ONE problem that plagues the amateur constructor is the shortage of trim hardware and other mechanical components that spell the difference between functional, but obviously "home grown," equipment and a smart "custom-commercial" product. Fortunately, the packaging problem has been fairly well solved by the various manufacturers of metal cabinets. The wide variety of types, sizes, materials and finishes available provide the amateur constructor with a selection that will meet the requirements of most construction projects.

With modern component parts and the handsome enclosures available, there is apparently no reason why every creation should not have that commercial finish. This, however, is not the case. Aside from downright sloppy workmanship, three factors are to blame for this condition. These deficiencies are poor panel layout, inadequate marking of controls and the lack of distinctive trim hardware.

Two of the problems, panel layout and marking, are usually easily solved. The control panel should be laid out to provide a balanced appearance and maximum operating convenience without reducing the efficiency of the equipment by poor electrical arrangement. Labeling and marking of the controls and control panel is not difficult. The complete and attractive decal sets, when applied in accordance with instructions, give professional results. A light coat of clear, spray lacquer will insure permanence of the markings.

The desirability of trim on amateur equipment is a controversial subject. The word "trim" brings forth a vision of gleaming chrome and this falls in the same category as caviar; some like it and some don't.

For those who do, a visit to the local hardware store will be profitable. Many new items of decorative cabinet hardware have entered the market and much of this has electronic equipment application.

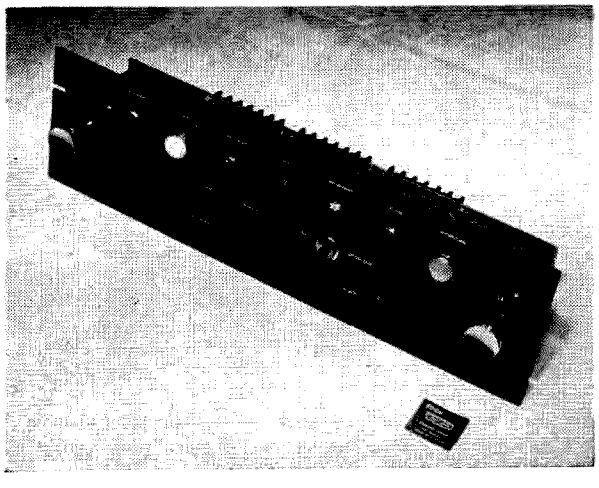
Panel handles for rack mounted equipment have long been on the market. However, these handles require two mounting holes and may not be immediately available. Sturdy, chrome plated kitchen cabinet knobs may be found in many hardware stores. These heavy, die cast units are quite attractive and are budget priced. The photograph shows two Sears, Roebuck and Company #5905 "Craftsman" cabinet knobs mounted on a rack panel. The bright chrome and the modernistic styling of these 1¼" diameter knobs provide a custom touch to the equipment.

Chrome plated cabinet knob back plates also have amateur equipment application. They are available in a variety of sizes, in both round and square types, and make ideal trim for various components. The photograph shows a Sears, Roebuck and Company #5907 "Craftsman" plate used as a mounting for a miniature meter. A 1" hole is punched in the center of the 2⅜" square plate and the assembly mounted by the meter mounting nut. Other components may be mounted in the same way and the chrome adds flash to any equipment.

Surplus BC-191 and BC-375 transmitters have supplied the variable inductors for many amateur transmitters. This unit is a fine component and, complete with counter dial, provides a low cost answer to the pi-network circuitry of medium and high power transmitters. However, regardless of how it is mounted, the existing dial is decidedly antique in appearance.

The photograph shows an up-dated installation of this dial. A Sears, Roebuck and Company, 2½", #6021 "Craftsman" cabinet knob is sawed off just back of the largest diameter. The back side is dressed smooth with a file and two holes are drilled in the knob. The hole in the center is used to secure the plate to the old dial and the second hole mounts the spinner crank. Credit for this one goes to W4SYJ. The modernistic result will be a credit to the finest equipment.

The ideas shown in the photographs and described above just scratch the surface. Visit your local department store and give your imagination a chance. Ingenious application of items designed for other purposes can save you money and provide a custom touch to your equipment. . . . W4WKM



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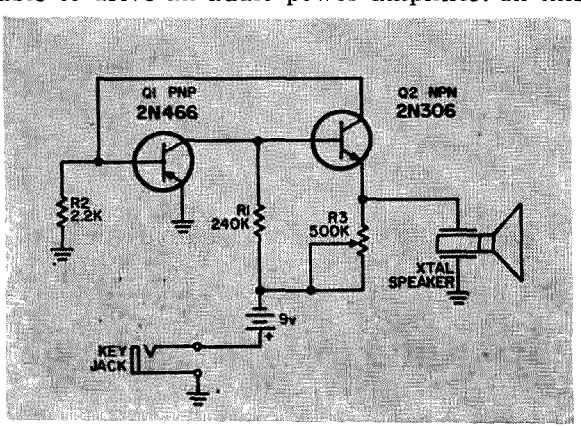
Roy McCarthy K6EAW

VARIOUS classes of amateurs, or amateurs-to-be, build code practice oscillators for numerous individual reasons. Among these are the desire to learn the code or to improve their proficiency, or to just plain build one for the fun and self-satisfaction of doing something or learning something. This oscillator circuit was intended along the latter lines, but it is very useful in keeping the old fist from getting too rusty.

The circuit uses the old PNP-NPN transistor arrangement which is commonly used to explain the PNPN type of transistor. Three resistors (actually two fixed resistors and a potentiometer) plus a crystal type pillow speaker complete the oscillator. Power is furnished by a 9 volt transistor radio battery, with a current drain of less than 100 microamperes. A crystal diode could be used to rectify a little RF from the rig for monitoring of your keying while transmitting, but the battery supply should be used until the oscillator is working satisfactorily alone.

The tone produced is quite pleasing, being very rich in harmonics. The actual waveshape across the speaker is nearly the same as that of a normal RC type relaxation oscillator. Sound pressure build-up in the piezo-electric crystal speaker does cause some distortion and flattening of the normal curve, and in fact the oscillator can be frequency modulated by blowing or talking into the speaker.

By now the reader has probably guessed the secret of operation of the circuit, in that the inherent capacity of the speaker is the hidden circuit component. The one used measured about .003 mfd. Incidentally, a number of pillow speakers have various low impedance coils, rather than a piezo-electric crystal—so be sure before you buy it. Lower tones than the range of the tone control can be produced by simply shunting the speaker with a fixed capacitor. Or omit the speaker, using only a capacitor, and about 9 volts of signal is available to drive an audio power amplifier. In this case the oscillator may work over a range of from a few cycles to 10 kc, depending on the size of the fixed capacitor.



The circuit is essentially a form of an astable multivibrator, in which both Q1 and Q2 are cut off until the emitter voltage of Q2 rises to about the same voltage as is on its base, which is applied through R1. The emitter voltage on Q2 rises at the rate at which the speaker capacitance is charged through the potentiometer, R3. Q2 is cross coupled to Q1, so they amplify regeneratively, causing complete conduction of both, thereby rapidly discharging the capacity. The cycle then repeats itself indefinitely or until power is removed by opening the key.

One peculiarity of the circuit should not be overlooked. The PNP transistor must be conducting slightly in order to amplify and enable the circuit to trigger. Therefore at very low temperatures where Ico of the transistors is low and the base to emitter voltage is increased, R2 may have to be increased in value, or omitted. At high temperatures the reverse is true. The values specified gave good operation with a number of similar transistors at normal room temperature. Incidentally, the crystal speaker could easily be ruined by leaving it in a closed car on a hot day, or exposing it to other sources of heat.

Construction is non-critical—a finished circuit works as well as the breadboard—which is unusual in present day electronics. If you use transistor sockets and find it a bit difficult to make solder stick to them a tiny drop of acid flux makes a world of difference. Needless to say, the acid flux must be carefully washed off with alcohol immediately after soldering, else stray leakage paths and corrosion will set in.

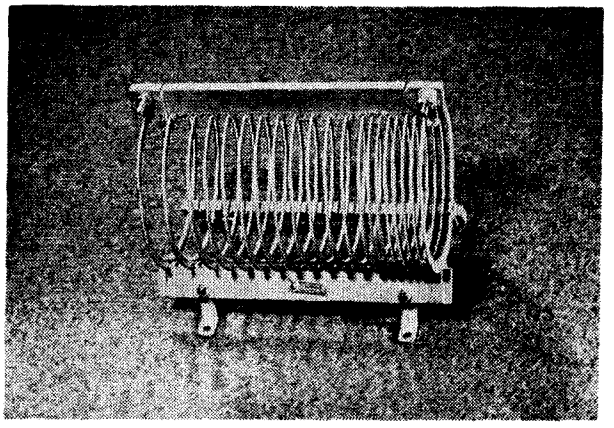
While the output is low, due to the low current drain, it is more than sufficient for code practice in the normal quiet ham shack. A major advantage is that it keeps the code practice in the ham shack, and not on the already cluttered up CW bands. . . . K6EAW

Variable Pitch Pi-Network Inductor

EDGEWOUND, copper ribbon inductors, similar to the E. F. Johnson Company 200 and 232 series coils, are frequently available on the surplus market at very reasonable prices. These inductors will handle substantial power levels and would be ideal for use in high power, tapped pi-network tank circuits except that constant pitch winding is employed. This complicates their use in band-switching circuitry since the required form factor may not be achieved at the higher frequencies.

Modification of these inductors for band-switching, pi-network use is a simple task. The

edgewound copper ribbon is supported by three notched Micalex bars and mounting feet are attached to two of these. The clips securing one end of the insulators are removed and the end turns pulled out of the coil. The spacing of the remaining turns is progressively increased by inserting the turns in every notch for the low frequency section, every second notch for the medium frequency section and every third notch for the high frequency section. The photograph shows one of these inductors modified in this fashion. Addition of ceramic post, mounting insulators complete the coil.



Total inductance and the positions of the taps will be determined by the desired LC ratio and circuit "Q" and these are fixed by the operating parameters of the final stage. After the tap locations are determined, copper strap leads are sweat soldered to the inductor and connected to the tap switch.

Suitable tap switches may also be found on the surplus market. Since military equipment is required to work into a wide variety of antennas, tank circuit voltages and currents are often extremely high. As a consequence, very heavy duty ceramic switches are used in relatively low power equipment. Use of these switches and the modified inductors will go a long way toward reducing the cost of high power amplifier construction. . . .W4WKM

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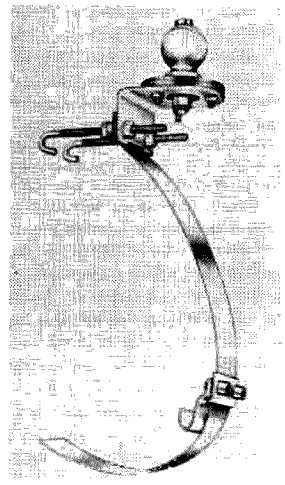
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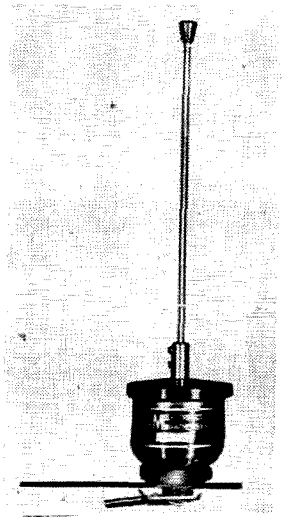


Bumper Mount

One of the major problems in bumper mounts has been the wide variety of shapes to be fitted. New-Tronics has come up with a clever solution to this puzzler: a flat alloy steel strap which fits tightly against any shape bumper, large or small. The whip receptical has a standard ⅜-24 thread and adjusts for vertical position of the whip. Wanna know more? Drop New-Tronics a card at 3455 Vega Avenue, Cleveland 13, Ohio.

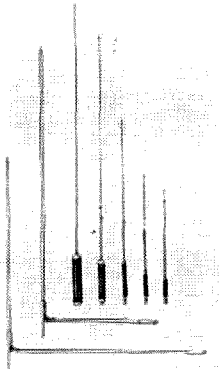
Index To Surplus

Roy Pafenberg W4WKM has come up with a really valuable idea. He has taken the time to check back through all of the past issues of 73, QST, Electronics World, Radio-Electronics, and . . . er, CQ, and has made a complete list of all of the articles that have appeared about surplus. Since this ran to over 100 manuscript pages it was obvious that we couldn't publish this in 73. Thus another book was born. We've gotten this set up in book form and had it printed for you. It lists all pieces of surplus equipment alphabetically and gives a listing of all articles on it and a digest of the content of each article. This should be invaluable to anyone interested in converting or buying surplus equipment. It also lists all of the surplus conversion books and their content. $1.50.



Car Roof Antenna

GAM Electronics has a new mobile antenna for roof-top mounting. This one only sticks ⅜" through the roof, leaving no bulge in the inside upholstery. Roof-top mounting provides a much better signal, eliminates dead spots and picket-fence effect. The TG-2-R has a half wave whip and a built-in matching transformer. It tunes from 144-160 mc. Brochure? Write GAM, 138 Lincoln Street, Manchester, New Hampshire.



All-Band Mobile Antenna

The engineers at New-Tronics have been extra busy of late and have come up with a fine arrangement for all-banding the mobile antenna. All kinds of coil tapping arrangements have been tried in the past and most of them lead to almost complete frustration on the part of the poor operator. N-T has a good practical system: separate resonators for each band. The base whip has a hinge arrangement so it can fold over for resonator changing or garaging. Each resonator can be matched to your particular car by tuning it with the stainless steel adjustable rod. There are two masts available, one for bumper mounting and the other for fender or deck use. New-Tronics will be pleased to send you further information is you'll card them at 3455 Vega Ave., Cleveland 13, Ohio.

DKC-RFB

SIGNALS 'POP OUT'

WITH DOW'S

PREAMPLIFIER

Get signals you didn't hear!



price . . . $10.75

Not a gimmick, but a tested and proven accessory. Precision made, fully backed by Dow-Key's traditional Factory Warranty.

HELP YOUR RECEIVER! The DKC-RFB Booster is a 50 to 70 ohm impedance matching "broadband pre-amplifier" guaranteed to increase the over-all gain by 1 to 6 "S" units on all bands (1.5 to 30 mc). To improve sensitivity, work with DX, and bring up weak unintelligible signals, you'll want a DKC-RFB. Designed for receivers up to the $300 class.

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ALL BAND TRAP ANTENNA!

Reduces Interference and Noise on All Makes Short Wave Receivers. Makes World Wide Reception Stronger, Clearer on All Bands!

For ALL Amateur Transmitters. Guaranteed for 500 Watts Power for PI-Net or Link Direct Feed, Light, Neat, Weatherproof

Complete as shown total length 102 ft. with 87 ft. of 72 ohm balanced feedline, Hi-impact molded resonant traps. (Wt. 3 oz. 1" x 5" long). You just tune to desired band for beamlike results. Excellent for ALL world-wide short-wave receivers and amateur transmitters. For NOVICE AND ALL CLASS AMATEURS! NO EXTRA TUNERS OR GADGETS NEEDED! Eliminates 5 separate antennas with excellent performance guaranteed. Use as inverted V for all band power gain. NO HAYWIRE HOUSE APPEARANCE! EASY INSTALLATION!

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SEND ONLY $3.00 (cash, ck., mo) and pay postman balance COD plus postage on arrival or send full price for postpaid delivery.

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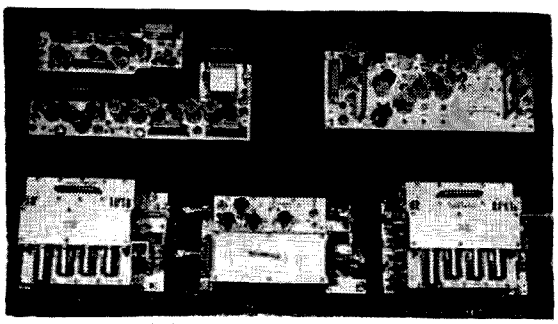
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BARRY ELECTRONICS

512 BROADWAY

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AN/SRT-14 SUB-ASSEMBLIES

Left to right, top to bottom: Frequency Converter Unit 11B; One mc Step Generator Unit 10; Frequency Converter Unit 9; 100 kc Step Generator Unit 8; Frequency Converter Unit 5; and Frequency Converter Unit 11A. These are described in more detail in the article on page 44. These units may be used separately or all together as a frequency synthesizer.

Unit 5 . . . $7.50	**Unit 10. $10.00**
Unit 8 . . . 10.00	**Unit 11A 5.00**
Unit 9 . . . 10.00	**Unit 11B 10.00**

All six units $40.00

These units are all brand new in their original cartons and are complete with tube shields, less tubes. Manufactured in 1955-56.

RITCO Box 156 Annandale, Virginia

LETTERS

Dear Mr. Green:

I was very interested in the article by your contributor, Roy Pafenberg, W4WKM, on the grid dip oscillator, in your January 1962 issue. Roy seemed to be very enthusiastic about the product, as well he should be. This Japanese import, at $36.95, is an almost exact copy of a wired version of the Knight-Kit G-30 Grid Dip Oscillator, which has been built by many hams all over the country. The price of the Knight-Kit is $22.95. As a ham I would prefer to spend only $22.95 and a pleasant evening building a grid dip oscillator. The Knight-Kit uses all American parts, but this is only a passing observation.

Lou Dezettel W9SFW

Dear Sir:

We will train you at home to operate Heavy Construction Machinery. If you answer immediately you will get the FREE Railroad Telegraphers Course. Would you like to be a Federal Postal Clerk in the club car of the Santa Fe Chief? Mix with Movie Stars?

First you have to do something for me. That's the American Way.

Last year I managed to buy a gift subscription to Batman on Sideband, or whatever you call your magazine, for a friend and I don't know when it expires but I would like to renew it for 2 years. However, I suspect I may be a little late and perhaps he lost faith and renewed it hisself. In other words I don't want to give you the money if you're just going to slip it in the beer kitty because he already came thru. If he did I'll still get him 2 yrs additional—he's only 40 or so—will you handle this please? Bill me or ask me for the money and fix his stencil.

Ken Cole W7IDF

WAYNE GREEN LOSES SHIRT

I have now proven positively that it is not possible to keep subscription prices at $3 per year and at the same time put out a larger magazine . . .even with the most rigorous economy measures.

	One Year	Two Years	Three Years	LIFE
Present subscription rates	**$3.00**	**$5.00**	**$7.00**	**$30**
New rates, effective March 1, 1962	**3.50**	**6.50**	**9.00**	**40**
New, new rate, sometime in the fall	**4.00**	**7.00**	**10.00**	**50**

All $3.00 subscriptions received after March first will receive 10 issues.
CLUB RATES: Club secretaries may send in subscriptions in groups of five or more and deduct 50¢ per subscription for the club.

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Start with: current issue ☐ next issue ☐

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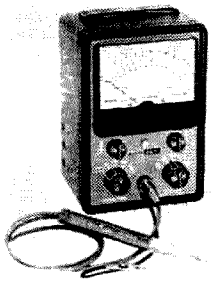
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☐ $30 LIFE ☐ Renewal (I think) ☐ New subscription (I think)

Start with: current issue ☐ next issue ☐

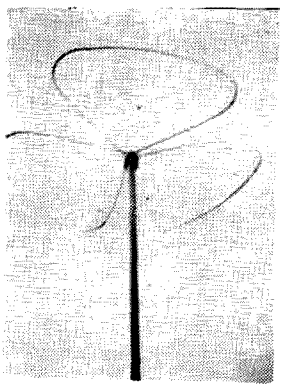
73 Magazine 1379 EAST 15th STREET, BROOKLYN 30, N. Y.

New Products



EICO VTVM

The EICO model 222 is available in kit form for $27.95 and wired for $42.95. This unit provides direct reading measurements of ac and dc voltages up to 1500 volts in 5 ranges and resistance from 0.2 ohms to 1000 megohms in five ranges. Handles ac from 30 cps to 3 mc, and up to 250 mc can be read using the HVP probe. Peak-to-peak readings are possible with the PTP probe. The regular probe has a clever switching arrangement for ac volts, dc volts and ohms.



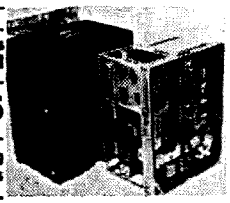
Big Wheel

Cush-Craft is justifiably proud of the new clover-leaf VHF antenna which they claim will provide a gain in all directions (360°) which compares favorably with a seven element yagi in its favorable direction when dual stacked! This new design looks sure to be popular. It provides an SWR of 1.2:1 or less over a 4 mc bandwidth and a gain of 5 db over a halo. A card to Cush-Craft, 621 Hayward Street, Manchester, N.H. will bring you the details.

SCR-522 SPECIAL

NEW LOW PRICE: $14.95 BUYS 2-METER RECEIVER & 2/6/10 METER XMTR

SCR-522 rcvr, xmtr, rack & case, exc. cond. 19 tubes include 832A's. 100-156 mc AM. Satisfaction grtd. Sold at less than the tube cost in surplus! Specify whether fob Bremer-FOB Bremerton, Wash. Wt 75 lbs. **$14.95**



Add $3.00 for complete technical data group including original schematics & parts lists, I.F., xtl formulas, instruct. for AC pwr sply, for rcvr continuous tuning, for xmtr 2-meter use, and for putting xmtr on 6 and 10 meters.

POPULAR Q-5'ER

BC-453-B: 190-550 kc; I.F. 85 kc. Use as rcvr, as tunable I.F., as double- conversion for other rcvrs. Checked out, good cond., w/schem., align. instr., pwr sply data, etc. RailEx only, fob Los Angeles **$12.95**

For Fixers: Same, inoperative.....$5.95

QX-535 RECEIVER

See p. 66 Dec. 73 or write us for reprint. This is the BC-453-B in handsome case with xfrmr-type pwr sply, speaker, all controls, phone jack, ready to plug in and use..... **$37.50**

NAVY'S PRIDE RECEIVER

RBS: 2 to 20 mc 14-tube superhet has voice filter for low noise, ear-saver AGC, etc. Strictly for communications! Very hot! I.F. 1255 kc. Checked, aligned, w/power supply, cords, schematic, instructions, fob Charleston S.C. or Los Angeles, Calif. Only **$99.50**

ALL-BAND RECEIVER

R-45/ARR-7: 0.55 to 43 mc A1, A2, A3. Unused Air Force surplus, cost Gov't $750.00! Includes our own 60 cy pwr sply for htrs, B+, and the DC for the rcvr's automatic tuning motor. This rcvr has everything! Xtl IF filter, 6 selectivities, BFO, S-Meter, AF/RF Gain, Noise Limit., etc. Sharp and Hot! Best buy today for DX. IF is 455 kc, ideal for double conversion with either BC-453 or QX-535 described above. Before shipping, we have a painstaking Communications radioman inspect each unit thoroughly, check it, align it, bypass reradiation suppressor, improve ant. impedance match and hang his OK tag on it. W/schematic, align, data, etc. absolutely ready to plug in and use . . . nothing else to do. FOB San Antonio, Texas..... **$197.50**

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AN/APR-4 rcvr is 11-tube superhet as I.F., S-meter, etc. for the 30 mc output of the tuning units. Aligned, OK, fob Los Angeles... **$69.50**

TN-16, 17, 18 tune 38-1000 mc; checked OK; the set of 3..... **$85.00**

TN-19, 975-2200 mc..... **$59.50**

LM FREQUENCY METER

Good, used cond. With matching calibration book, xtal., schematic, power supply data. F.O.B. Pensacola, Florida. Only..... **$49.50**

SAME, but less calibration book..... **25.00**

AC PWR SUPPLY for TBX & LM

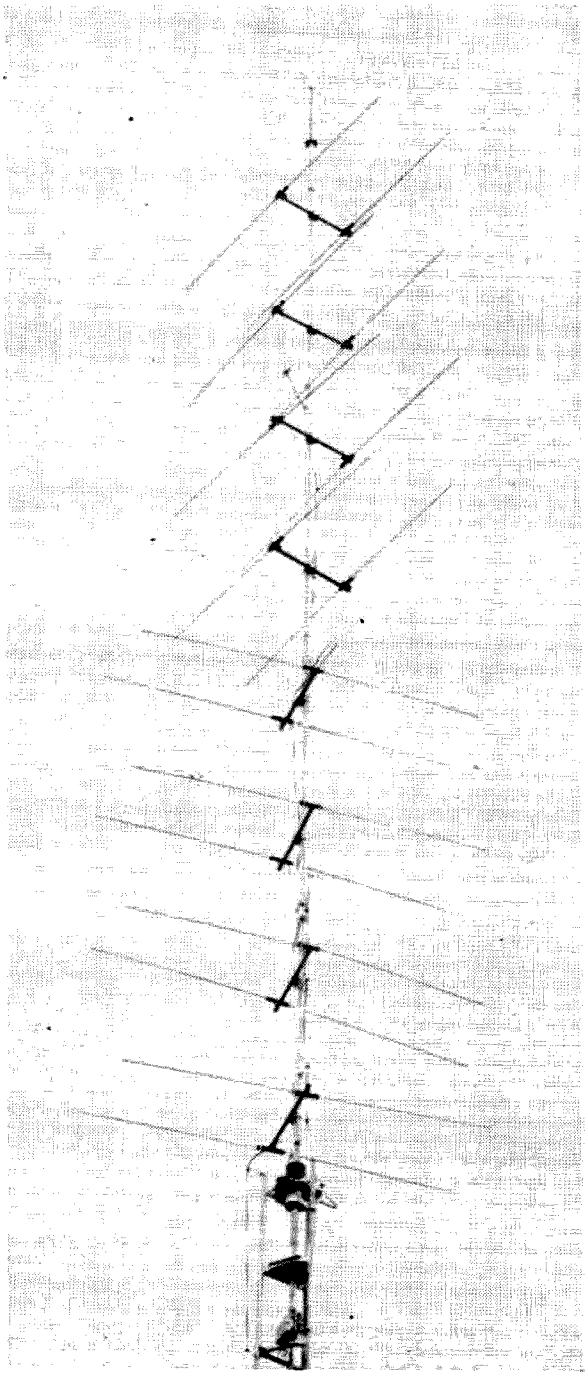
EAO. Made for TBX rcvr, furnishes all required voltages. Input 115 v 60 cy. Brand new, original pack, with spares. With mating output plug, schematic, and conversion data to higher outputs (for example 200 v 40 ma, plus 6.3 v 2 A). FOB San Diego, Calif. **$14.95**

For use with LM freq. meter add $3.00 for "LM pwr kit" which includes LM input plug, revised schematic conversion, and parts needed for the 12 v LM heater requirement.

TIME PAY PLAN available for any purchase over $150.00 total.

R. E. GOODHEART CO.

BOX 1220-GC BEVERLY HILLS, CALIF.



Split 32 on 2

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio

BEING naturally curious (nosy) I like to hear what's going on in the area on 2 meters. The standard 16 element collinear is an ideal monitoring antenna due to its very broad horizontal pattern, but it will still operate in only one general direction. The Split 32 is a set of two collinears mounted on the same tower using two independent rotors. When properly connected together, it permits nearly independent operation in any two directions with 32 elements available for one direction when required.

The graph shows that the actual performance is just what might be expected. Curve A is the pattern of the 32 element antenna rotated as a unit. The F/B ratio is about 9 db, and the beam width 55 degrees. This is an unusually broad pattern for 32 elements because they are stacked *up* rather than side by side. The vertical pattern will be extremely sharp.

Now if only one of the sets is rotated, curve B results. Notice that when the sections are at right angles the response in the original direction drops only 4 db, or 1 db less signal than would be received with a plain collinear in the first place. This proves negligible interaction. But any signal in the new 90° direction is increased about *34 db*. When the two sets are phased for maximum foreward gain there is a slight cancellation when they are placed back to back. This is due to the 180° phase difference between the small back pickup and the main lobe signals.

Fig. 2 shows the feed system used. I brought both feedlines into the shack for versatility. The SWR of each antenna on the coax side of the balun read less than 1.2:1. Since the true impedance is thus very nearly 52 ohms, the common feed point would be 26 ohms. A quarter wave section of 36 ohm line (two pieces RG-59U in parallel) restores the line to 52 ohms. By keeping all lines at 52, a transmitter can be connected to one, or both sections of the antenna with only minor retuning.

Exact construction details are not available since the antenna just grew. The inner mast is two 12′ sections of very heavy 1¼″ aluminum tube. The outer mast (lower beam) is a 12′ section of 1⅝″ aluminum tube. Nylon or Teflon spacers are used in the space between these to prevent binding as the antenna bends in the wind. The entire antenna weighs about 40 lbs. Two alliance automatic rotors are used. Anyone attempting to build a similar antenna should consider a heavier outer mast, as the present assembly sways vigorously in a strong wind.

The results of using the Split 32 for several months have been most interesting. Both sides of a QSO can be easily monitored or you can join into otherwise impossible three-ways. One section can be used for experiments while the other remains on duty. And last but not least, such an antenna could be invaluable for emergency operation.

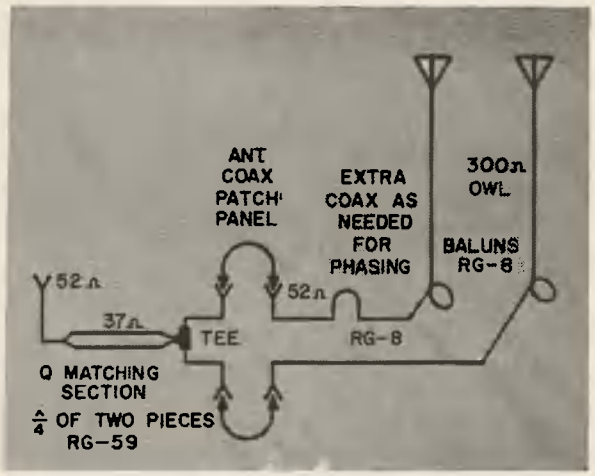


Fig. 2

Swan SSB Transceiver

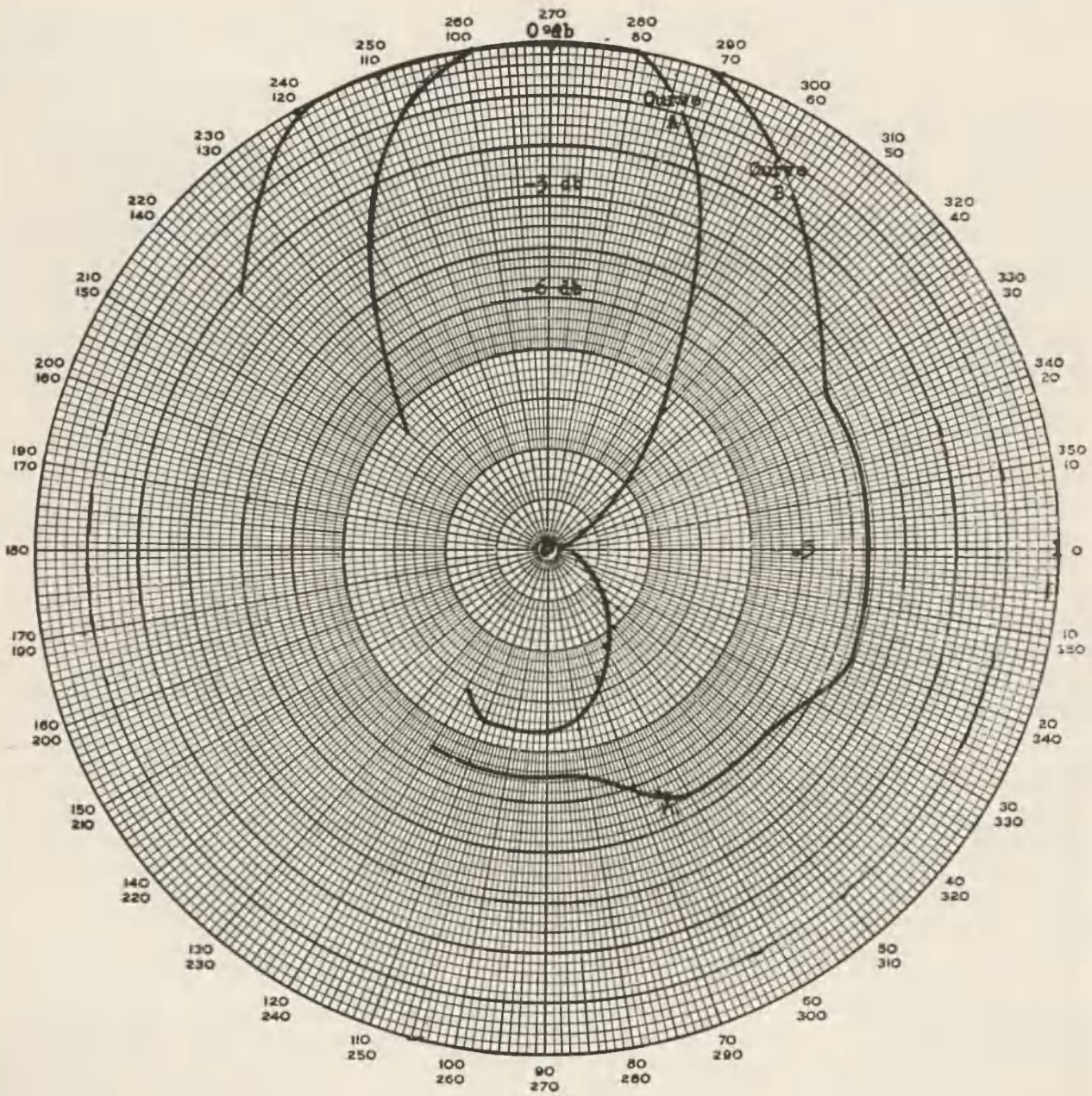


$275
Net

One band 130-watt transceiver.

See our ad in January 73 or send for spec. sheet.
Available for immediate shipment SW-120-140-175.

ELLIOTT ELECTRONICS, INC.
418 N. 4th Ave. Tucson, Arizona



Curve A: Rotating 32 elements. Curve B: Rotating upper 16 elements, lower 16 elements fixed.

More New Products

GLASS BREAKS

Yes: J. J. GLASS finally broke down and moved his incredible surplus buys across the street to new quarters.

If'n you're out this way drop in and see our huge new place and the huge new stock that we had to buy to fill it to the rafters. If'n your're not coming by then send for our free catalog. Our prices are so low it's almost like shoplifting.

J. J. GLASS CO. 1624 S. MAIN L. A. 15, CAL.

RCA CRM-P2A-5 Citizen's Band Transceiver, 1-channel, crystal, full 5 watts input. 6/115V or 12/115*. Complete with cables, instruction book, FCC forms, mike-spkr.

11 lbs. shipping wgt. per unit.
*Specify which. $39.50 ea. $75.00 pr.

Original COLLINS KWM-1 DX Adapter Kit with instructions. Allows xmting and receiving on different channels. NEW $15.00 postpaid.

Western Electric dial telephone. Exc. cond.....$4.95 ea. 2 for $8.95

Radiosonde Tronsmitter—T-304/AMT-4A, 1650 MC with RCA 5794 tube and gnd-plane antenna.....$2.50 pp

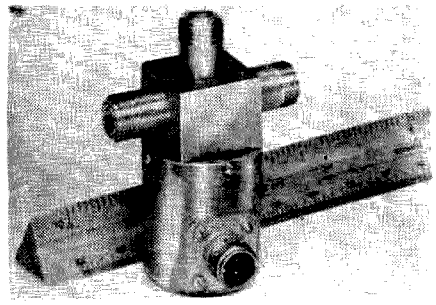
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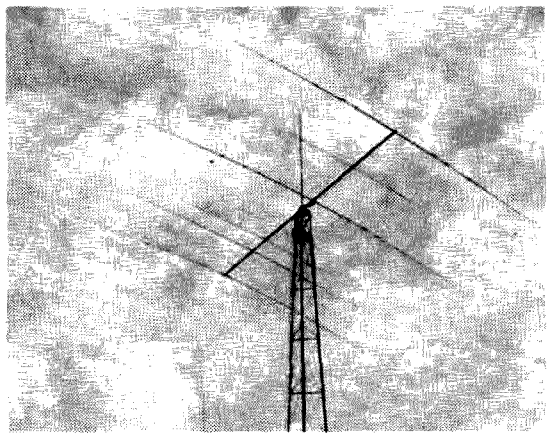
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HAM-TV (see Jan. '62)	3.00
HAM-RTTY	3.00
1962 Amateur Radio Yearbook	.75
Index To Surplus	1.50
Cumulative Index (Jan. '62 issue)	.10



Coax Switch

Bay-Roy has a new one: One pole double throw, with built-in connectors for your choice of BNC-UHF-TNC, etc. The coil uses 115 vac. Works up to 1200 mc. and is rated at 75 watts, making it ideal for receivers and medium power transmitters. Write Bay-Roy, Box 7503, Cleveland 30, Ohio.

Only $985.00!



Telrex seems to be out in front in the announcement of expensive antennas. This monster four bander is fed with a single coax feeder and gives you a whopping signal on 10, 15, 20 and 40 meters. This gives you three elements on 20 and 40, and four on 15 and 10. The boom length is 33' and the beam is designed to operate best at the 61' level. Weighs only (?) 175 pounds. There is some question as to how many distributors are stocking this model and even fewer have it on display. Maybe you'd better send for info from Telrex, Asbury Park, New Jersey. If you mention it they will also throw in dope on their Duo-Band Kit Antennas. They may even throw it in if you don't mention it.

February Last Year

We have a few copies of this issue available for those of you that missed it the first time around. 50c each. There were sixteen feature articles in this issue, starting with a combination six meter and eighty meter transmitter (tuned up to the MARS 4.4 mc frequency),

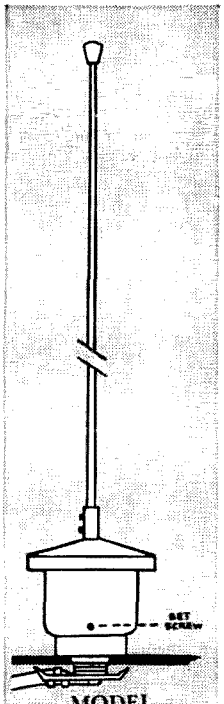
complete with power supply and modulator. 60 watts fully plate modulated. Next we have a simple two transistor microphone amplifier that will fit right in the base of your mike. This is particularly designed for use with the Varicap Modulator described in the October 1960 issue of 73. Jim Kyle comes up with what is billed as the "World's Simplest Phone Patch." While it does not give you all the features of the commercial units available, it does have the virtue of being able to be built in about ten minutes from an old power transformer and a potentiometer (100K to 2M), which is pretty virtuous.

Two meter addicts will get a kick out of the extremely compact three tube two watt rig using three 6CX8's. We've had a lot of compliments on this one. Ed Cole W7IDF came up with one of the best humor articles we've printed so far in his, "Squawk." You've probably heard someone read this over the air by now. The Kyle six meter car converter using 12v on the plates has met with mixed reviews. Several fellows have written in that they've built it and it works very well; others have had trouble. The Heath Hybrid Phone Patch was reviewed in this issue. As ever, Heath has a fine product and gives excellent dollar value.

One of the most discouraging things about working with transistors is their tendency to go pffft! K6EAW explains how to avoid this difficulty. This article is of considerable value to anyone who is transistorizing. The Big Technical Article for February is on Beat Generation wherein we cover the subject of BFO's in detail, giving the circuits for all popular circuits, discussing the pro's and con's of each, and then presenting you with the best known circuit for the chore.

Ed Noll W3FQJ explains how to update the shack wavemeter and give it a lot more functions . . . like how to use it for providing the oscilloscope with a modulation pattern. Kyle has a cute idea for getting rid of audio interference: an adapter for the first audio tube which isolates the rf and bypasses it. Cures tvi-bci-hai-etc. W4API has an interesting dissertation on how to tune up that mobile whip and get the most out of it. W7OE delves into the remote antiquities of ham radio and shows us the beginnings of the modern VFO. The EICO Grid Dip Meter is given a thorough wringing out by W3UZN . . . we approve. Kyle has a small power supply for those surplus Super-Pro's. Simple unit, uses two filament transformers back to back for the HV supply with silicon diodes in a doubler circuit. Clever. W4WKM shows us some uses for the popularly available polar relays. W2LZX gives us a list of all of the known flying hams, must be a couple hundred at least.

That was quite an issue. We still have a few left which are available at 50c each until the supply is exhausted.



MODEL
No. TG-2-R
(144-160 mc)
PAT. PEND.

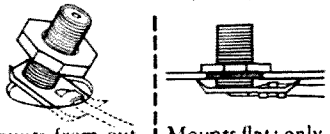
AVOID CEILING BULGE

Now you can buy a miniaturized gain * antenna for your "ROOF TOP" without ceiling bulge!

* Same db gain as TG-2

- SWR better than 1.5 to 1 with 52 ohm line.
- Hermetically sealed matching transformer.
- Less than 2¼" above roof.
- Will stand up to 150 watts RF power.
- Stainless spring steel whip, ½ wave long. May be cut to your specific frequency.

EASY TO INSTALL
no need to remove upholstery!



Mounts from outside by insertion through ⅞" hole.

Mounts flat; only uses ⅜" inside roof.

Special Frequencies Available
Comes Complete with 12 Foot Cable

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ATK—TV camera w/iconoscope and all tubes. At about ⅛ last surplus price and 5% of gov't price. L/new. 79.95
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ATX—Transmitter used w/ATK-camera, incl. antenna. 39.95
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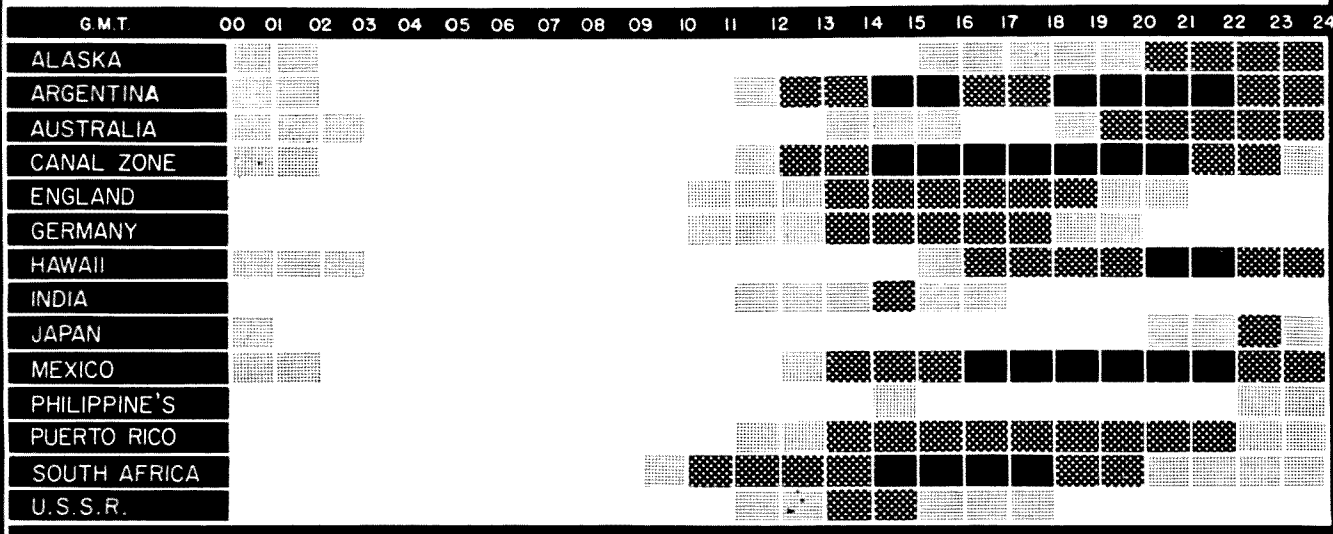
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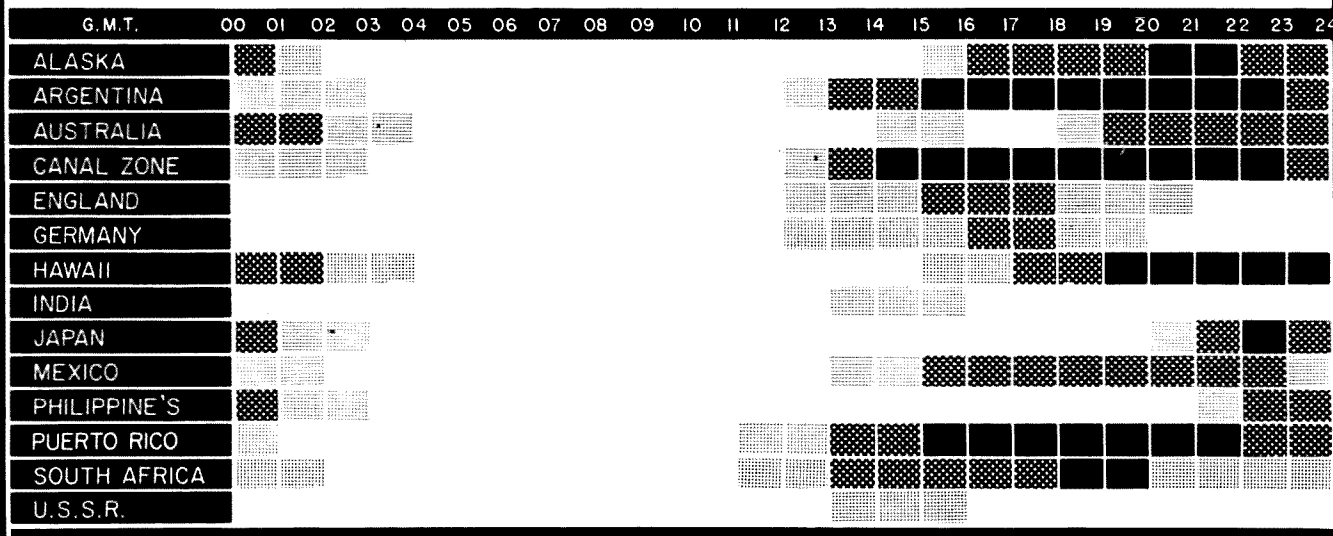
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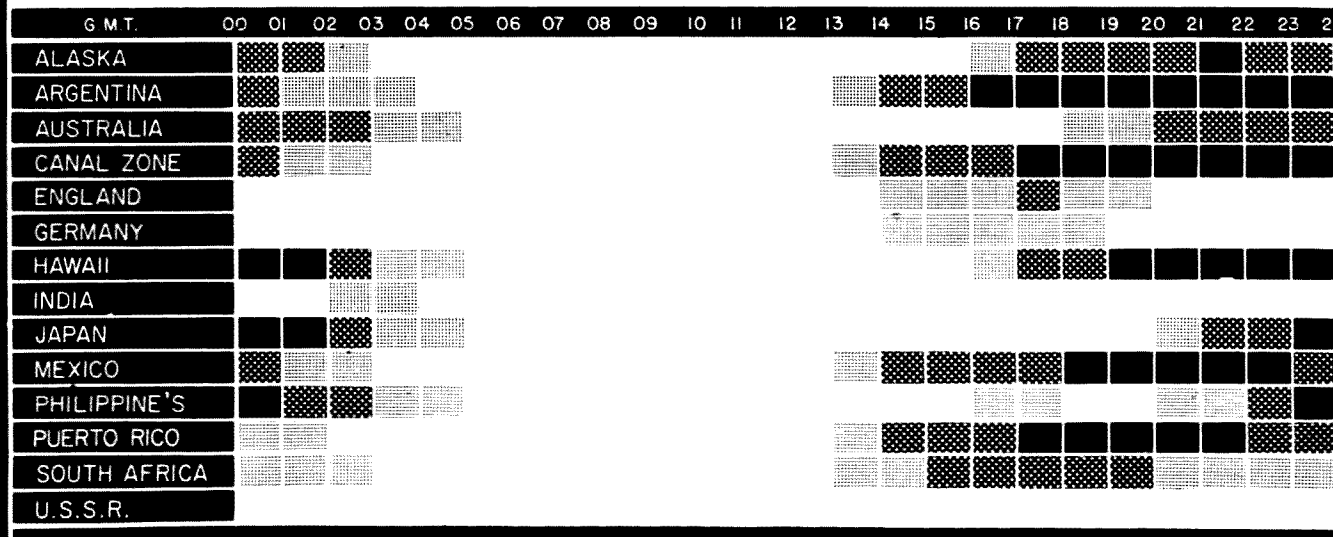
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Propagation Charts

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For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

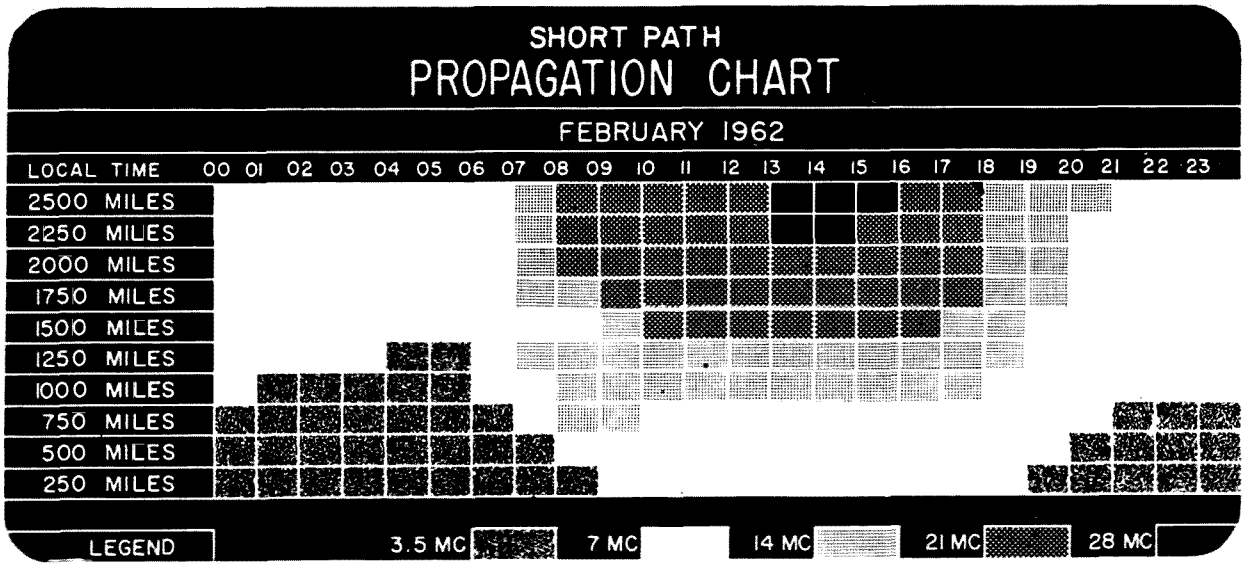
Advance Forecast: February 1962

Good: 1-3, 8-23, 27-28

Fair: 4-5, 7, 24-26

Bad: 6

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HB to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.



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An Economy Antenna Tower

Earl R. Murphy W8HOA
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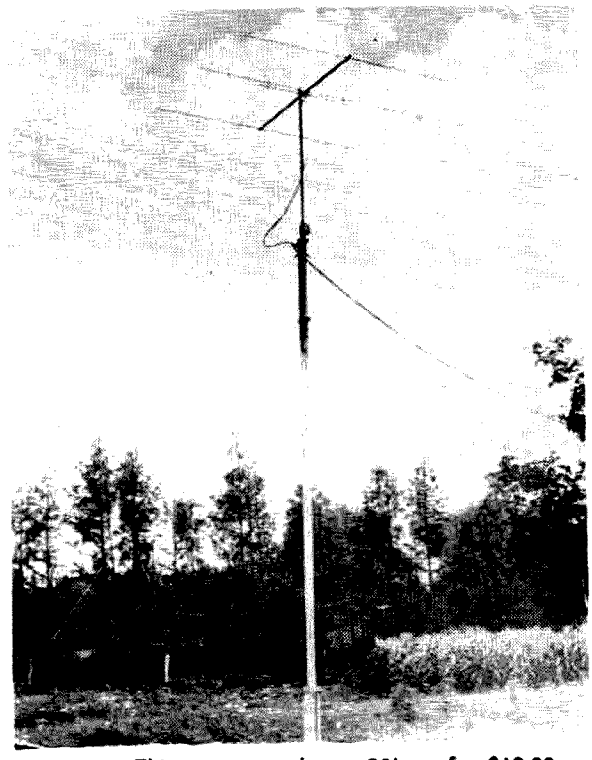


Fig. 1. This puts your beam 30' up for $12.00.

ARE you one of those hams that, for lack of money or time or both, hangs his beam antenna on the nearest convenient high point and hopes for the best? If you are then get the beam off that chimney mount o rback porch roof and enjoy the advantages of good antenna performance that can be realized only by using an antenna tower. Towers cost too much you say? Well here is one that doesn't! The total cost for materials for the antenna tower described in this article should not be more than twelve dollars. This tower will put your beam twenty-five to thirty feet above ground, making this one of the lowest dollars-per-foot towers in existence. This tower is strong enough to support a rotor and one or more beam antennas and can be constructed with little effort using ordinary tools and readily available materials.

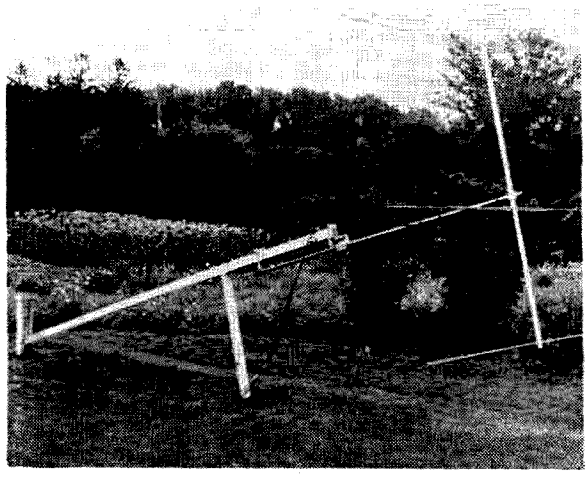


Fig. 2. Mast pivots over for work. 2" x 4" used as a prop.

The tower, shown in Fig. 1, is of the semi-self supporting type, that is, the main strength is in the base and mast portions and the light guy ropes, which are optional when using light weight antennas, serve only as tethers to prevent excessive sway in high winds. Another desirable feature is a pivot arrangement which allows the mast portion of the tower to be raised or lowered while the antenna is in place. The lowered mast is shown in Fig. 2 where a 2" x 4" is used as a prop to keep the antenna from supporting the weight of the rotor and mast. This pivot arrangement is especially convenient as one can stand on the ground and work at a comfortable height while making the initial antenna installation or subsequent adjustments and then the antenna-mast assembly can be swung up into position ready for operation.

The tower is made up of two sections; the main upright, or mast, and a base to hold the mast. The following briefly outlines the steps to be used in construction of the tower.

The base is made of two eight foot 2" x 6"s joined by a five foot 2" x 4" as shown in Fig. 3. A half inch hole for the pivot bolt is drilled through both 2" x 6"s 28 inches from the top and the entire base is well painted to prevent deterioration. The base is buried to a depth of five feet in the ground. As the hole around the base is refilled, the dirt should be firmly packed and the base frequently checked with a level to be sure it remains vertical. As can be seen, the 2" x 4" provides a bearing surface in the narrow direction of the 2" x 6"s.

The mast is a good quality 24 foot 4" x 4". A half inch hole is drilled six inches from the

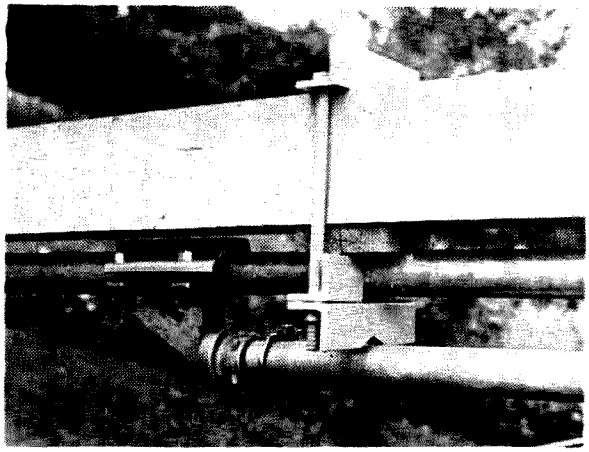


Fig. 5. Clamping arrangement detail.

bottom end for the pivot bolt and the entire mast is well painted to prevent weathering. Screw in three eye bolts six inches from the top and attach the three tether ropes. The top of the base must be clamped to the mast when the mast is in an upright position and a good clamp can be made from two ½" x 8" machine bolts and two iron straps ⅜" x 2" x 8" or alternatively two pieces of angle iron 1½" x 8". The straps (or angle iron) are drilled one inch from either end with a half inch drill. This clamp is shown in position in Fig. 4. When this clamp is tightened the friction between the mast and the base holds the mast firmly upright. A word of caution here. Do not attempt to fasten the mast to the top of the base by using a bolt through the mast. The bolt hole will seriously weaken the mast at this critical point.

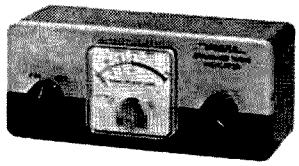
The antenna can be mounted at the top of the mast, or by using a standard 1¼" O.D. aluminum television mast the antenna can be extended as much as five or six feet above the top of the wooden mast. This aluminum television mast can be clamped directly to the wooden mast, or as shown in Fig. 2 a short section of television mast is used to provide a base for a rotor and thrust bearing. Fig. 5 shows a closeup of a clamping arrangement using three pieces of one inch angle iron five inches long and two ⅜" x 7" machine bolts. The wooden spacer allows clearance for mounting the rotor and thrust bearing. The antenna or aluminum mast can be attached to the wooden mast by any of a number of arrangements.

All that remains to be done is attached the antenna and transmission line and swing the mast up into position. Clamp the base to the mast and attach the guy ropes to their anchors. It should be re-emphasized that these guy ropes act as a tether and are not intended to support the tower, hence they should not be drawn up tight.

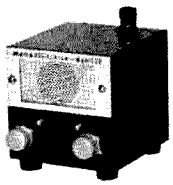
After a year of service at this QTH this tower needs no maintenance and appears as good as ever. Considering the investment, I believe this is one of the best towers available. So if you need an antenna tower of modest height and are long on "need" and short on cash, this is the tower for you.

. . . W8HOA

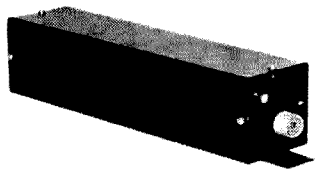
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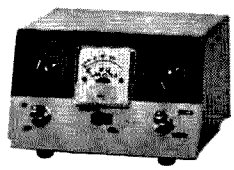
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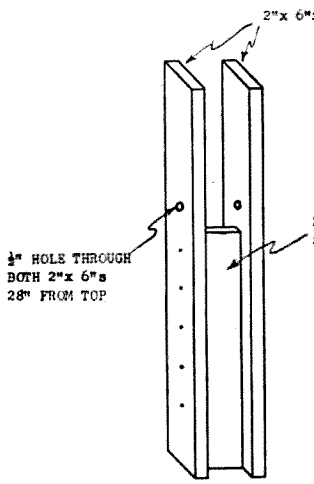


Fig. 3. Base.

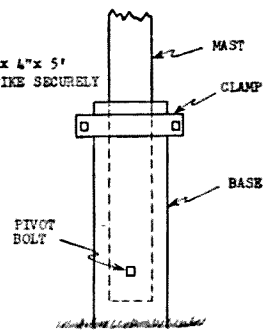
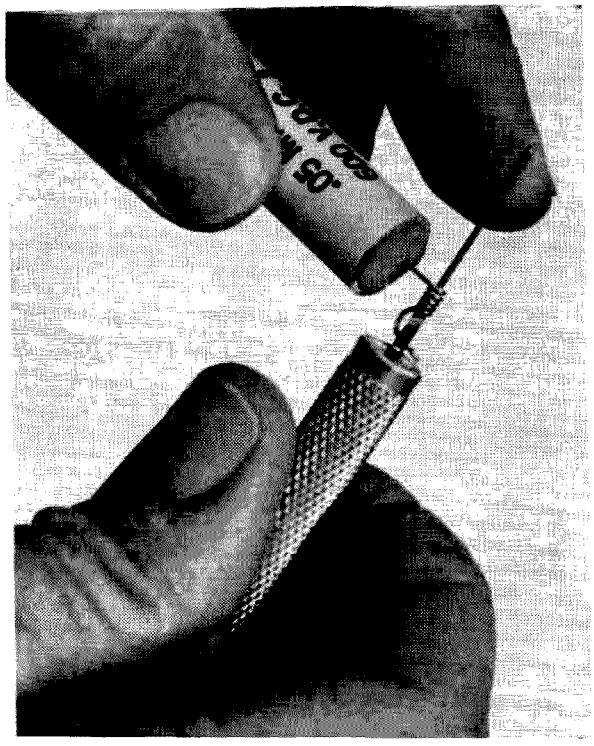


Fig. 4. Base clamp on base.

Parts List:

Quantity	
1	4" x 4" x 24' knot free wood for mast.
2	2" x 6" x 8' knot free wood for base.
1	2" x 4" x 5' knot free wood for base.
3	2" x 2" x 2' (wooden guy anchors).
1	½" x 7½" machine bolt (pivot bolt).
2	½" x 8" machine bolt for clamp.
2	⅜" x 2" x 8" iron strap for clamp.
3	metal eye screws.
100'	plastic covered nylon clothesline rope.

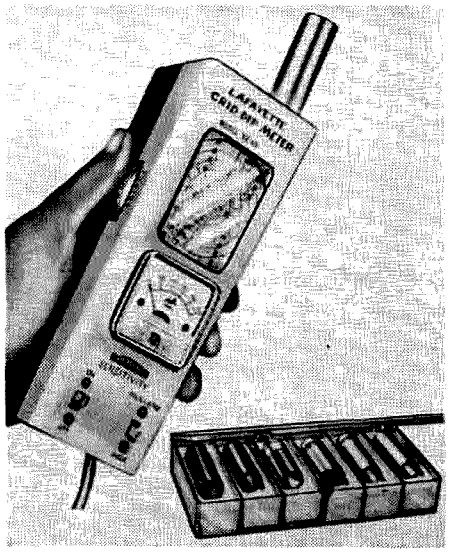
More New Products



Wire Wrapper

Leave it to a ham to come up with a bright idea like this. Henry, W5IVU, has put a gadget on the market which makes it very simple to put a twirl on the end of a resistor or condenser lead. This sure makes it so you won't have any cold-solder joints or have to wrestle parts to hold them in place while you try to solder them. The twirled wires easily hold the part. The twirling gadget is available from Twirl-Con, 1101 N.E. Street, Edna, Texas. $2.

Lafayette



TE-18
G.D.C.

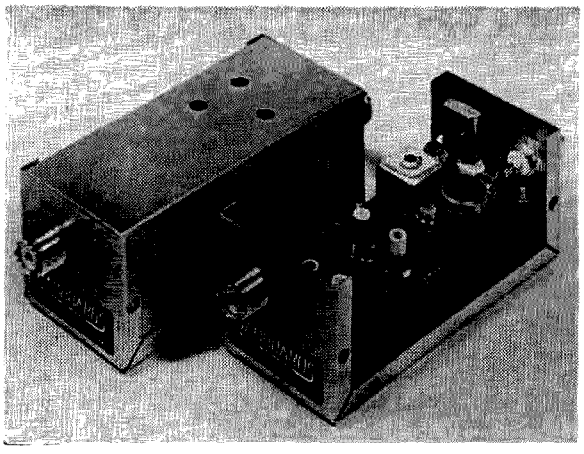
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Hamboards have a nice deal for you. They have just announced a new line of converters for six and two meters. They are crystal controlled and completely transistorized. You can use flashlight batteries, the car battery, or borrow a few milliamperes from the cathode of an audio stage to power the converter, making them fine for mobile or fixed use. Noise figure is 4 db! The converters are complete and ready to use for $44.95 (six meters) and $49 95 (two meters). The printed circuit board and coil sets are available separately for do-it-yourselfers. Write Hamboards, Box 13158 Pine Castle, Florida for complete information.



(W2NSD from page 4)

You can find someone who collects almost anything. In this case it is K3HNP and he saves call letter license plates. He is still short plates from W7 states and VE1. He particularly likes old ones, the older the better, and wrong call area plates such as my W2NSD plate from New Hampshire. He'll pay the postage. Send 'em to David Heller, 14 Darkleaf Lane, Levittown, Penna. He'll take those call letter plates you've just taken off the car too.

37¢

The other day I took time to sit down and calculate what it costs us to print copies of 73. Very distressing. It costs about 18¢ per copy! You think that is OK for a 37¢ magazine, eh? Well, first of all you should figure what we get per issue on subscriptions. On one year subs we get 25¢ per copy, which isn't too bad, unless you calculate in the cost of mailing out the twelve issues, the cost of the addressing stencil, and the cost of handling the subscription . . . all of which puts the deal in the red. A two year subscription works out to 20¢ per copy, which is even redder. Fellows sending in for three year subscripitions usually congratulate themselves on how much they are helping us. Ha! At 19½¢ per issue we are not doing very well. Postage varies with distance, but fortunately for the post office we have a huge following in California.

Perhaps this explains why we are still running around in rags. At any rate, it should be obvious that as the magazine grows larger it will be necessary for us to increase the subscription rates and the newsstand price. Advertising cannot grow to fill the gap because we are not going to let the magazine fill up beyond about ⅓ with advertising on the perhaps mistaken principle that most readers buy the magazine to read the articles. If you prefer an all-advertising magazine please let me know right away and we'll save thousands of dollars now being squandered in high living by our authors.

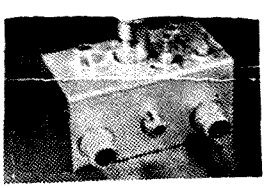
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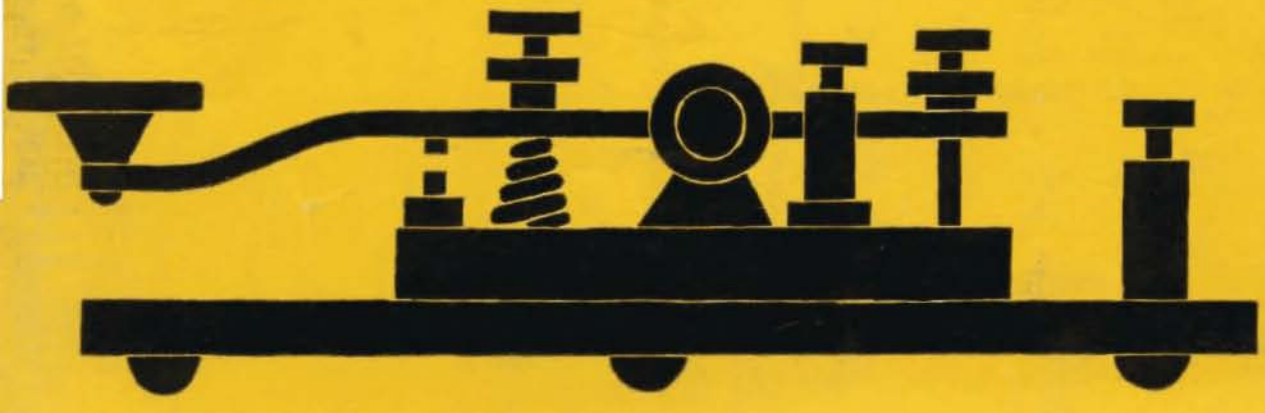
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73 Magazine

March 1962 • Vol. IV, No. 1

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Ham TV is sprouting up all over. This will bring you up to date on its spread.

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Think piece.

The Tiny Terminator ..... Jim Kyle K5JKX/6 38
50 ohm 20 watt dummy load built in Canada Dry Cola can. Too bad if this is not your brand.

Old Vikings Never Die ..... John Bauer W4AWM 40
Little hints to improve the Viking rigs. Might work on the DX-100 too.

73 Tests the Knight T-60 Transmitter ..... Roy Pafenberg W4WKM 42
Here's another rig we can recommend. 80-6 meters, 60 watts, CW-AM.

Antenna Protection and Switching Unit ..... Carl Drumeller W5EHC 46
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Is Marconi Like Spaghetti, Daddy? ..... Sylvia Margolis XYL G3NMR 50
Saga of the visiting amateurs, as reported from England.

Faithful, Long-lasting, Signal Booster ..... Joe Smith W9ZDN 52
It also works well and is simple to build.

Evolution of the Bug ..... Louise Moreau W3WRE 54
Historical aspects of this oft used, little mastered device.

Cure that Angry Band ..... JIM Thompson W4THU 57
Audio selectivity with the FL-8 surplus audio filter.

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Keeping BC stations out of your receiver.

73 Tests the Viking Ranger II ..... Charles Spitz W4API 61
Johnson has nicely updated their most popular rig.

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You can mix the full output of your exciter to any band you desire.

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Propagation Charts ..... Dave Brown K2IGY 74

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WØRQF RTTY . . . Pt. II 90

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. . . never say die

Undependable

The annual boating show hit New York at about the same time as the last issue of 73 and all of the papers ran special boating sections. My estimate of 400,000 boaters turned out to be a rememberance of the attendance at this show, not the number of boating enthusiasts. It seems that there are now over 8,000,000 registered boats in these here United States. My estimate of their average expenditure was a little closer, being closer to $1500 per year than the $800 estimated.

How many hams do you know that put that kind of money into ham radio? Darned few!

Like any other interest, the more you put into ham radio the more fun you get out of it. The more I'm referring to isn't necessarily money, though cash is an important ingredient. When I look back at what I consider the high points of ham radio operating I can see that each of them took a lot of extra effort, plus some capital.

Though I've always enjoyed operating on the VHF's, the real fun didn't start until I went to the effort to cook up an amplifier for my Gonset. Once I had 500 watts perking and a 24 element beam I found that I could work anything I could hear and usually I got 'em on the first call. The number of answers to my CQ's was enough to keep any hungry ego well inflated. When aurora was in full bloom I could get on there and work anything coming through. What a difference this was from low power operation with a small whip where I was lucky to contact anyone outside of Brooklyn!

Two meters from a small plane is something I won't ever forget either. You have that DX feeling with the whole band coming back to you every time you stand by. Neglecting the effort involved in getting the plane and learning to fly it, there were the miseries of beating the ignition noise down to where I could hear anything through it, battery problems, antenna impossibilities, and so forth. But it sure was a ball.

Then there was the time I set up my two meter station on top of the News Building in New York, complete with sixteen and five element rotary beams. Even with a 522 rig I found that I was working from Delaware to Rhode Island with amazing regularity. The fun I had operating from there was worth many times the difficulties I had to surmount to get the permission and set up everything. It was even worth the permanent case of wobbly knees that I developed putting up my rotary beams thirty feet out on that ten inch wide ledge, with a 70 foot drop on one side and a 500 foot chasm on the other.

This was on a par with the idiocy that drove me onto the roof of the New York City Municipal Building one night during a blinding rainstorm. The roof was slick slate and slanted at about 30°. It took everything I had to hold on and put up that ground plane for two meters. I won the VHF contest that year, so maybe it was worth it.

My trips to Mt. Greylock, Mt. Mansfield and Mt. Washington have been told before. There is not one of those trips that I'll ever forget. These were sort of junior DXpeditions and I'd recommend your giving something like that a try. It even makes a great club activity. The Windblowers Club over in New Jersey puts on a big "Blow" every year with several mountain top stations operating simultaneously for a day and a certificate to every station that manages to contact all of their outposts.

The last word in this kind of activity is the full fledged DXpedition. This sort of thing is worth many times the dollars it costs and the months of preparation. Not one of us that went on the Navassa Island Expedition (KC4AF) will ever forget one minute of that trip. I note that most of the fellows have since gone on more trips like that. I sure wish I could manage to get away again some time. You can bet that I'm doing everything I can to make it so that eventually 73 Magazine will be sponsoring some DXpeditions. Heh! Heh!

Which brings me back to my original idea that the more you put into ham radio the more fun you will have. When I visit a chap with 100 watts and a dipole and operate his station (as I have done a couple hundred times or so) and compare this with operating a kilowatt station with a good beam, there just is no question about who is having the most fun. It is like comparing the fun of a row-boat to

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that of a speed-boat. I've done a lot of low power dipole operating with my own station and I find that somehow there is no substitute for an antenna and an amplifier.

For all our grumbling about "those high power stations," there are relatively few hams that take the time and effort necessary to put out a first rate signal. Sam Harris W1FZJ always comes to mind in this respect. Sam has a peculiar emotional difficulty: he cannot be happy on any band unless he has the loudest signal in the world on that band. I haven't visited him recently, but I believe he operates on 75M, 50-144-420-1296 mc. This entails quite a forest of towers and beams.

Hmmm, now lets' see, where is that catalog? I've got to order a tower for that twenty meter beam and I might just as well get right at it.

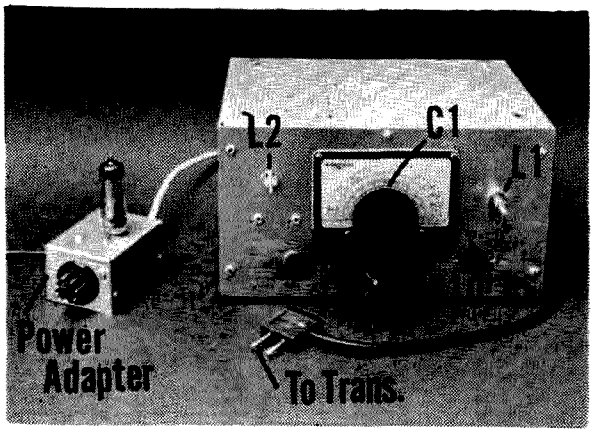
Clubs

Radio clubs are an integral part of our ham radio hobby and it behooves us to spend some time and energy in keeping them going the best way we can. Unfortunately it is far easier to kill off a club than make it flourish. While there are a few clubs that go on year after year in good health, we find sickly clubs more the rule than the exception. It would be nice if I could present you with a neat little list of things you should do to keep a club in good operating order, but I'm afraid that this has not yet been reduced to a science.

Though I have slept through the greater part of many club meetings, I have stayed awake enough times to arrive at some conclusions of my own as to what makes a club meeting interesting and what defeats it. The one big factor in the success of a club, I feel, is the smoothness of operation of the executive committee. If this committee is running smoothly they will second-guess the club members on almost every item which might ordinarily come before the club during a meeting and hash out all pro's and con's, sort of predigesting problems for the club. Then, during the meeting the results of the committee's thinking can be presented, together with all of the factors that went into their decision. This should cut down tremendously on the amount of time that the entire club has to spend in discussions.

Many clubs get all wrapped up in endless business meetings which seem to keep everyone engrossed at the time, but which don't seem to keep members coming back for more. Whenever there is an argument there must be at least two sides. This means that every time you have an argument you are going to have losers and these chaps may have been voted down, but they haven't changed their minds about the argument. They are still convinced they are right and they'll never be

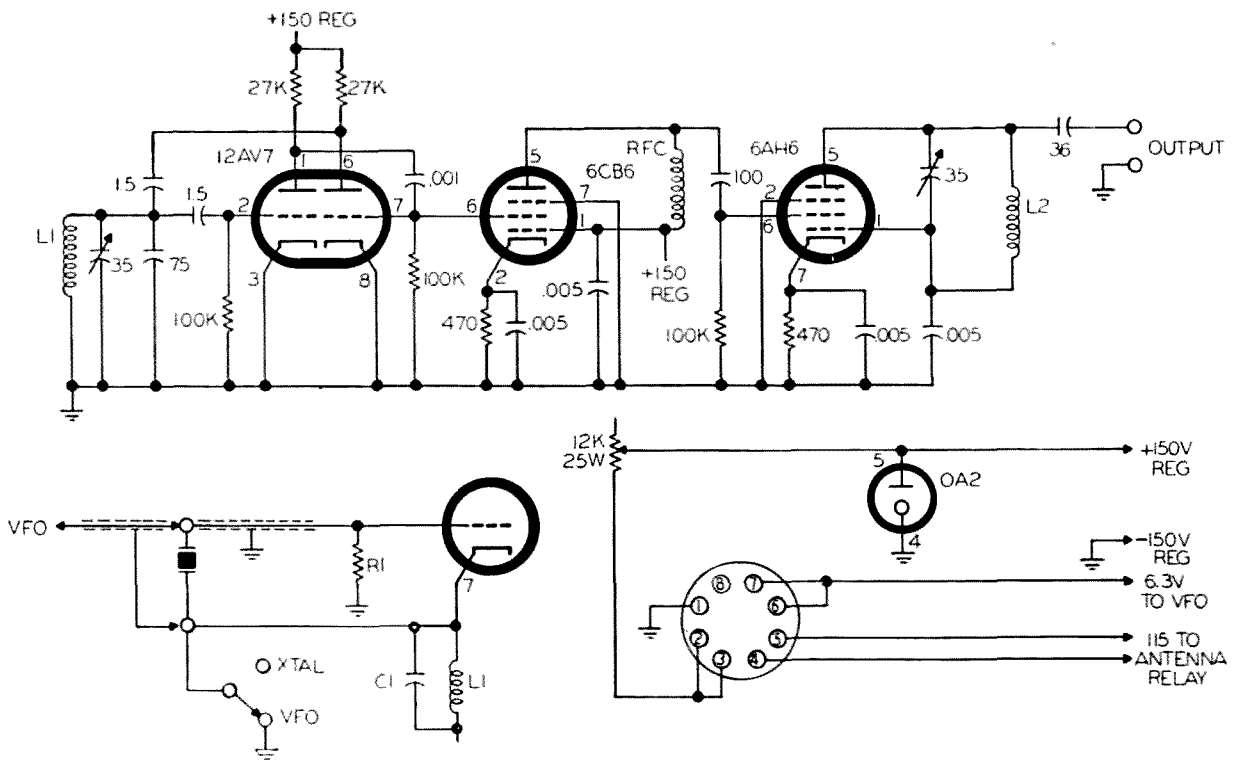
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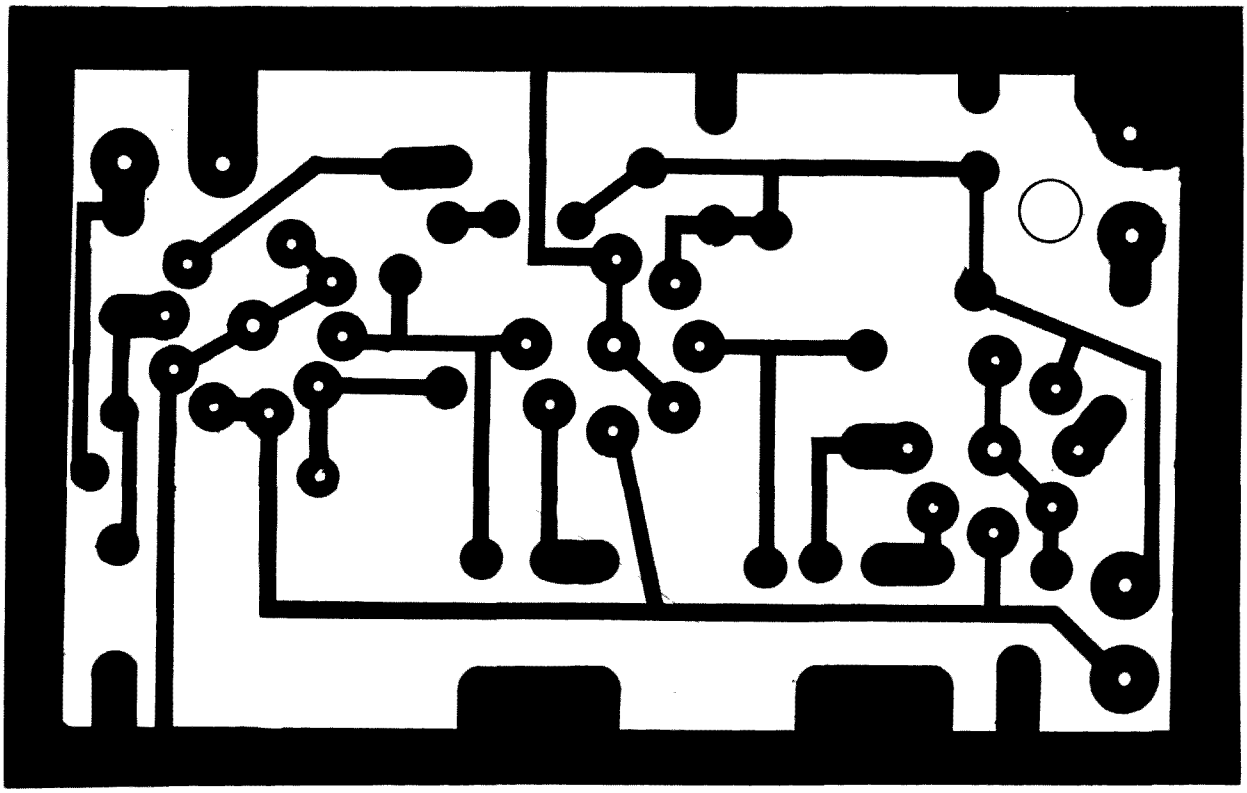


Printed Circuit VFO for 50 mc Transmitters

Irving Seligman W5UB
402 McNeel Rd.
San Antonio 28, Texas

THE control of the frequency of HF transmitters for many years has been accomplished by variable frequency oscillators, commonly called VFOs. They have been called many other things when their use has resulted in undesirable frequency stability, chirps and etc. that have been attributed to the nature of the beast rather than to the shortcomings of a particular unit. The one to be described here has been used successfully in conjunction with SSB rigs on the HF Bands and, in this particular instance, to control the





Printed Circuit Board—Actual Size

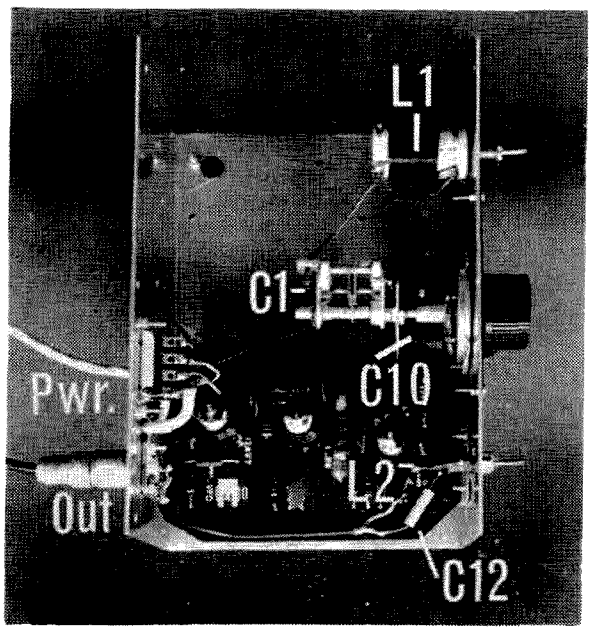
frequency of the author's "Globe Hi-Bander" on 50 mc without too much gnashing of teeth and tearing of hair either by the operator or the recipients of its results.

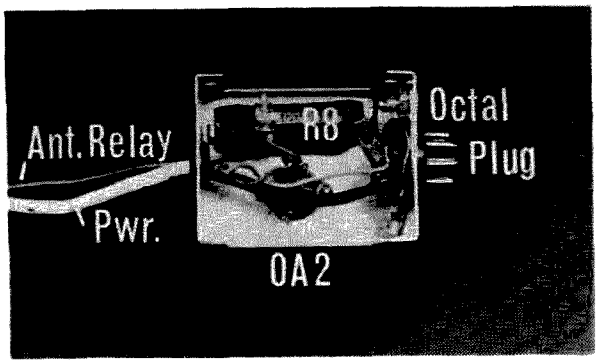
The circuit used in this unit is the product of Don Stoner, inappropriately termed the "Driftless VFO." There just "aint no such animal." But be that as it may, and with due respects to my author colleague, it is a fine circuit; and while not "driftless" in the strict sense of the word, it performs admirably. The VFO consists of a 12AV7 oscillator (Franklin type), a 6CB6 buffer and a 6AH6 doubler. The oscillator operates from 4.165 to 4.5 mc, with doubler output from 8.33 to 9.00 mc, which is satisfactory for rigs requiring xtals frequencies in this range, as does the "High-Bander." It obtains its power from the octal Accessory socket at the rear of the transmitter. The power requirements are 25 ma at 150v regulated (plate) and 1.20 amps. at 6.3v (Fil.) This can readily be secured from the transmitter without overloading its supply. The rated load of the final (120-125 ma) can be slightly reduced without too much loss of output if you are worried about the transmitter transformer 'going west.'

The only changes from the published circuit in the Sideband handbook are:

1. The grid resistors of the 12 AV7 are reduced to 100 K from 1 meg. (I bet that was a misprint.)
2. The coupling capacitor from the buffer to the doubler is reduced from .001 mfd to 100 mmfd (Ditto)
3. The doubler is a 6AH6 instead of a 6CB6 to secure an increase in output.

A cabinet, 9" x 6" x 5", of heavy guage aluminum was available in the junk box. It did not have too many extraneous (?) holes and quite a few in the right places which resulted in its being used to house the contraption. The photograph shows the placement of the various parts. Special care was taken to isolate Coil L-1 from the heat producing elements of the unit (tubes) in an effort to minimize instability due to heating. Variable Capacitor, C-1 was mounted on a heavy aluminum bracket, securely fastened to the





cabinet in order to eliminate mechanical frequency 'shakes.' Having on hand a number of etched circuit boards for this particular circuit (adv.) it was decided to follow this mode of construction. All parts with the exception of Coils L-1, L-2, C-1, C-2 and C-10 are mounted on the 6" x 4" circuit board. Of course if you want to be strictly square you can build the unit the old-fashioned way on a metal chassis (ugh). It's so easy simply to drill holes in the circuit board, mount the parts in the designated spaces and solder (more adv.). The power cable enters the cabinet thru a rubber grommet and is fastened to a terminal strip from which leads are run to the P. C. board. The output is connected to a coax chassis connector. The coax lead to the transmitter is terminated in a crystal holder which plugs into the xtal socket of the transmitter.

The power plug for connection to the Accessory socket is mounted on a 2¾" x 1¾" x 2" Minibox. This box also contains the parts and circuitry shown in Fig. 3. The photograph shows the mounting arrangement. Leads are also provided to obtain 115 v ac to operate the Antenna relay. Plate voltage is automatically applied to the unit when the Transmitter Function switch is in the Tune, AM and CW position. Filament current is applied to the unit when the Transmitter AC switch on the gain control is turned to the "On" position. A separate filament transformer may be desired by some users in order to keep the unit "warm." If such is the case, it may be outboarded anywhere but on the VFO case. The voltage output from the transmitter measured 470 v. on 'Tune' and 400 v. on AM. It is necessary to adjust the slide on R-8 to cause the OA-2 regulator, to glow in either position of the Transmitter Function switch.

The oscillator of the Hi-Bander has a tendency to oscillate when the VFO is connected in the manner recommended by the manufacturer. This is putting it rather mildly. The blank thing takes off like a jet airliner. It can be restrained by replacing the grid lead from the 5763 to the crystal socket with a piece of coax as shown in Fig. 2. It is also necessary to ground pin 7 of the same tube when using the VFO. This was accomplished by mounting a single pole double throw rotary switch in the space just above the transmitter crystal socket and wiring as shown in Fig. 2.

With the coil and capacitor values given the VFO covers 50 to 54 mc in the full 180° rotation of C-1. As a result 50.0 to 51.0 mc is about 45 degrees of the dial. If more spread on this portion of the band is desired by those who only populate that section of the band, C-1 should be made smaller and C-2 larger until the desired spread is obtained. However, it should be remembered that lots of DX was worked when the band was from 56-60 mc and the high end of the present band is open more often than most people realize it.

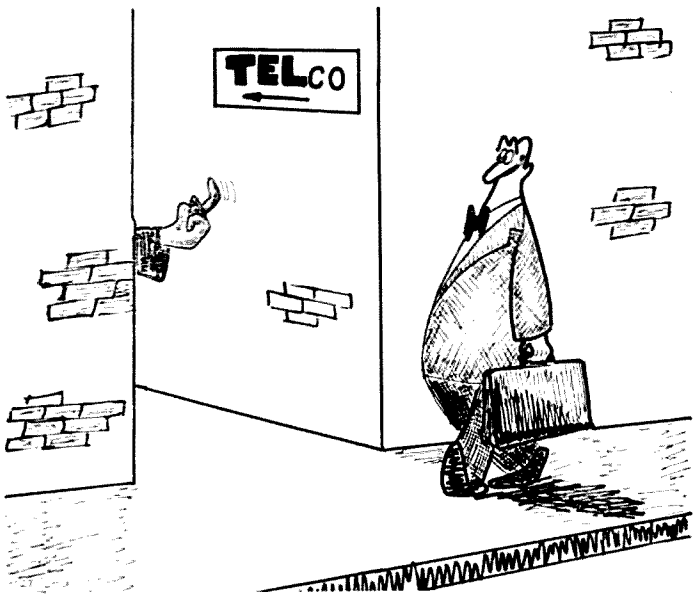
The unit was connected to the power socket and "warmed up" for about an hour before calibration. This was done with the transmitter function switch in the "Tune" position. The VFO can also be stabilized by running filament voltage from a separate source for a similar period. The re-set accuracy of the unit depends largely upon the mechanical stability of the dial. However, do not rely entirely upon your receiver or VFO calibration for good accuracy. A good frequency meter is indispensable if you must operate close to the band edges on any band. The following frequencies are given as an aid to calibration and hold only where the final frequency is the 16th multiple of the starting frequency:

VFO Frequency	Operation Frequency
8.333 mc	50.0 mc (Band edge)
8.416 mc	50.5 mc
8.500 mc	51.0 mc
8.583 mc	51.5 mc
8.667 mc	52.0 mc
8.750 mc	52.5 mc
8.834 mc	53.0 mc
8.917 mc	53.5 mc
9.000 mc	54.0 mc (Band Edge) *

No checks were made to determine how many cycles the frequency changed per degree or temperature rise. It has given satisfactory results as judged by the lack of squawks begotten by excessive dial twisting to keep track of its signal. The only one received was when the electric fan in the shack was too close to it and wobbled the frequency at a 60 cycle rate. So beware of fans in the Ides of August but have fun in busting in on your rivals choice DX.

P. C. Board including tube sockets available from Irving Electronics, P.O. Box 9222, San Antonio 4, Tex. for $2.25 postpaid.

Fig. 1—All resistors ½-W carbon except as noted.
C1—Hammarlund MC-35S (remove all but one rotor and 2 stator plates).
C2—75 mmfd silver mica.
C10—35 mmfd variable (Hammarlund HF 35).
C12—36 mmfd ceramic.
S1—SPDT rotary switch (CRL no. 1460).
L1—27 Turns #24 enamel close wound on National XR60 slug tuned form—1" dia. x 1¾" long.
L2—9/16" length of #28 close wound on ¼ slug tuned form.

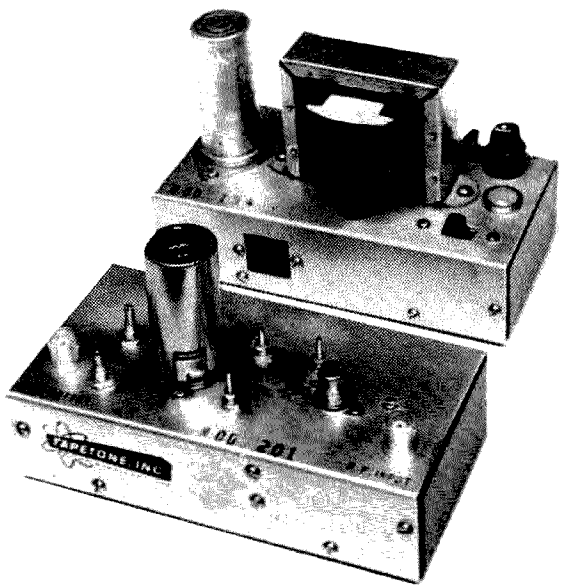


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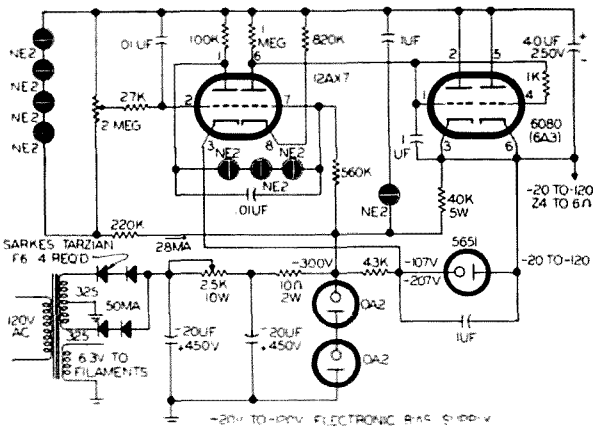
Regulated Bias Supply

Vernon Trexler W5IUR
2459-A 45th
Los Alamos, New Mexico

A stable bias is needed if you run your linear amplifier class AB2. As the tubes draw grid current the bias supply voltage must not change, the bias supply must present a low impedance to this grid current, otherwise distortion will result. The regulated bias supply is very convenient when you need to set the plate idling current at some specific value in linear operation.

A battery could be used for this service, however if you need to change the voltage for different operating parameters or run your amplifier Class A through C as the need arises, you will need a variable bias supply. Batteries also have a tendency to change in time when used as a bias supply.

Some electronic bias supplies do not have a great enough voltage change to meet the different operating classes when using large tubes such as the 4-250A, etc.



With these requirements in mind, a variable voltage bias supply was developed for a grid current range of 0 to 70 ma and a voltage range of -20 to -120 volts, and an impedance of 4 to 6 ohms presented to the amplifier grid circuit.

The circuit is unique in that it uses small NE-2 neon bulbs to hold various critical voltages constant. A 5651 voltage regulator tube is used because of its higher current rating as compared to a NE-2 in one location in the circuit. The circuit gives the various voltages and currents to expect at different points, and should be self-explanatory.

The 12AX7 is used as a sensing unit to vary the resistance of the 6AS7 so that as the grid current changes the impedance presented by the 6AS7 does not vary, thereby presenting a constant impedance to the grid circuit for varying currents.

The author has used this circuit for almost a year in a pair of 810 modulator tubes and a final rf amplifier using a pair of 4-250A running class A, AB_1 and AB_2 and Class C and has been very pleased with the results.

Other Hams have built the supply and only one problem has presented itself, the four NE-2 in series sometimes do not light properly. If this occurs, substitution of other NE-2's will cure the problem.

Be sure to follow the polarity marking on the schematic for the electrolytics. It is very convenient to bring the potentiometer to set the bias out the front panel of your amplifier. Be sure to shield the leads to this pot.

The power supply for the bias supply is voltage regulated and the current through the two VR tubes is set for 15 ma with the bias supply operating but not in use.

The author is indebted to Dr. Ralph Partridge for assistance on this project.

. . . W5IUR

Calls of the Past

Most radio amateurs are familiar with the present system by which the FCC issues radio call letters. For any given district in the 48 contiguous states, the "W" calls are issued from (numeral) AA through (numeral) ZZZ, skipping the letter X, to holders of Extra, Advanced, General, Conditional, and Technician Class licensees. "WN" calls are given to Novice Class licensees. When this series is used up, the FCC shifts to "K" and "KN" and repeats the process. The next step is the "WA" and "WV" series.

It has not always been so simple, though. In past years distinctive calls were issued for now-forgotten special purposes. Did you know that for many years the "Y" block of calls (like W5YJ) was not issued to stations owned by individuals but was reserved for colleges, universities, and other institutions of learning? The "X" block has always been reserved for non-amateur, experimental stations. Until the mid-thirties, "Z" calls were issued only to holders of a "Special Class" station license which authorized additional privileges, usually as to operational frequencies.

Portable and mobile operation required additional station licenses and call letters. "W10" (W ten) calls were issued for aircraft mobile operation in all call districts. Call letters for portable operation outside of your own call area began with the letters "ZZ". This meant that some calls had four letters after the numeral (like W6ZZAJ).

. . . W5EHC

How to Check Transistors with an Ohmmeter

or: Let's Cheat

Don Grayson W9QKC
2144 East 12th Street
Indianapolis 1, Indiana

WHAT the ham needs is a good go-no-go way of checking transistors with a piece of gear that he already has. Most transistor testers give you all sorts of exotic numbers and are expensive. What we want is a method to cheat and get a good idea of the quality of the transistor for the least fuss and cost.

First let's examine the transistor to see what is available to measure. Fig. 1 shows the equivalent configuration of a PNP transistor. You will note that it is shown as two diodes, the emitter and collector with a common cathode, the base This is actually how the transistor is made. It operates by injecting a little current into the base which controls the number of electrons that flow from the collector to emitter. This, basically, is all there is to transistor action.

At first glance it would appear that, since the transistor is just really two diodes, we could just take an ohmmeter and measure the forward and backward resistances of the two diodes. We would set it up as in Fig. 2 and if the transistor were good we could expect results like those shown. This test will give us some information about the operation of the emitter-base and collector-base diodes but leaves us in the dark whether it has even any gain or not. In other words it does not test the basic operation of the transistor. In fact the transistor can have a collector to emitter short and still have good diode action on both the emitter and collector. Well, you say, "Why not measure between the emitter and collector, that will surely detect a short." Sure it will, but define a short. Remember that now we are not measuring the ratio of forward to backward resistance, but the backward leakage resistance of one diode in series with the forward resistance of another diode. What will be a good number for one transistor will be a dead short for another. There would be a tremendous variation in this resistance from a small signal silicon rf amplifier to a germanium audio power amplifier. And we still know nothing about whether the thing will amplify or not. Besides, the manufacturer does not normally give such data anyway. What we want is a foolproof method of deciding if the thing is "transistoring" even though it was invented in Russia in 1933.

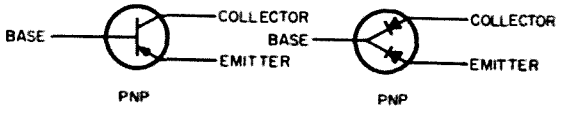
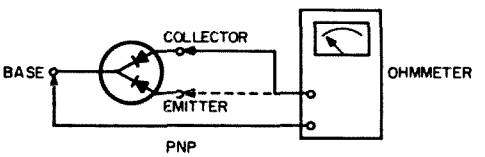
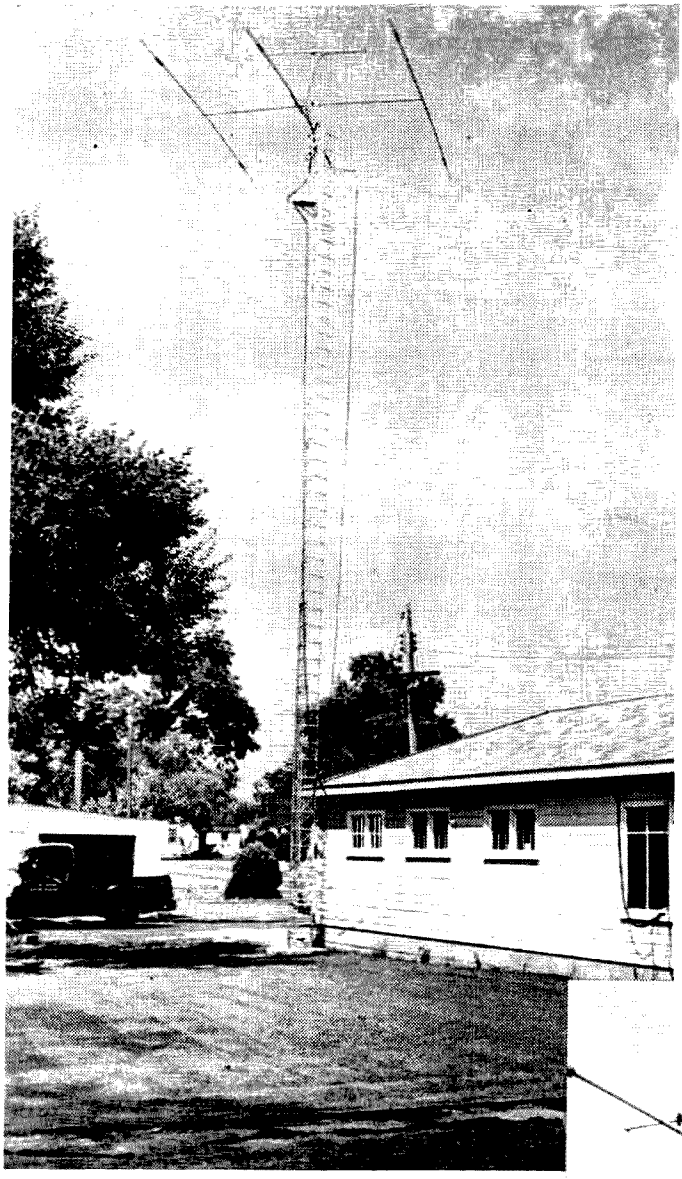


Fig. 1. At the left is the symbol of a standard PNP transistor. At the right is the equivalent physical configuration of this transistor. Note that it is actually two diodes tied to a common point, the base.



BASE	COLLECTOR	RESISTANCE	BASE	EMITTER	RESISTANCE
+	−	HIGH	+	−	HIGH
−	+	LOW	−	+	LOW

Well then, let's set the thing up in a circuit like it is supposed to work and squirt some current into the base to see if the current going through the collector-emitter leads does increase. If we are careful about polarity we can use our trusty ohmmeter to do this. An ohmmeter is nothing but a battery in series with a resistance and a meter. Assuming that we want to test an NPN transistor we merely place the positive test lead on the collector and the negative lead on the emitter. A small amount of leakage current will flow which will be indicated as a resistance on the ohmmeter. The theory says that if we apply a positive voltage to the base the current in the collector-emitter circuit should increase. Well that's easy enough to do, just push the base lead over until it touches the positive collector lead. If the transistor has any gain the collector-emitter current should increase. Of course since we are using an ohmmeter our indication will be a decrease in resistance. As a further check push the base lead over and touch the emitter lead. This effectively grounds the base and the current in the collector-emitter circuit should decrease from the value of current with the base left floating. This,



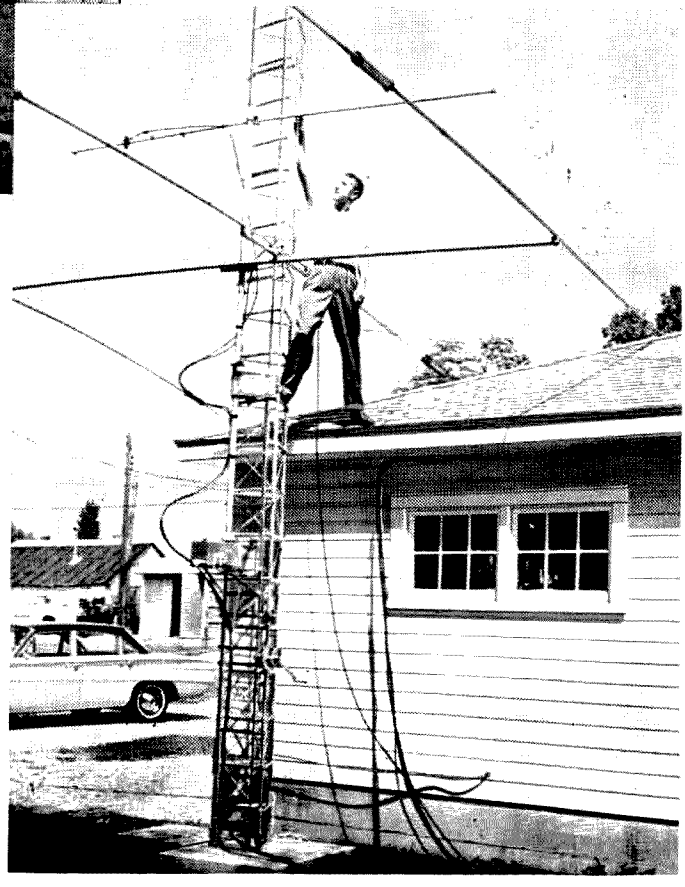
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Sullivan, Illinois

of course will be indicated as an increase in resistance on our ohmmeter.

Notice that all of these measurements are relative to each other, we don't have to have any data or "reference." Actually in each configuration you are measuring a basic parameter of the transistor, and, if you happened to have the curves for that transistor, you could check them. In the first configuration with the base open the measured parameter is I_{ceo}, current through the collector-emitter with the base open. The second configuration with the base tied to the collector is actually a measurement of the transistor's beta. (The manufacturer usually calls this h_{fe}). The third configuration is a measurement of I_{ces}, current through the collector-emitter with the base shorted to ground.

It is a bit hard to obtain exact numbers on these parameters as we are looking at a linear representation of basically a logarithmic device. If the collector-emitter current does go up when we apply the proper bias to the base we know that the device has a beta and it is "transistoring." This information is augmented by the action of the current when the base is grounded. On a dc basis we can now select a "hot" transistor from several of a similar type by picking the one that shows the greatest resistance change.

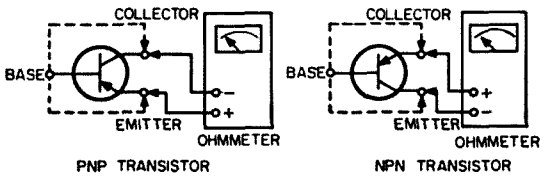


Fig. 3. With ohmmeter in R x 100 scale (assuming that the meter uses a 1½ volt battery) a good transistor will be indicated by a decrease in resistance when the base lead is touched to the collector and a small increase in resistance when the base lead is touched to the emitter.

Now that we have examined the basic idea let us look at the details. Fig. 3 shows the basic circuit using both NPN and PNP transistors. In each case proper transistor action is indicated by the resistance going down when the base is connected to the collector and up when the base is connected to the emitter. Normally the resistance change when the base is connected to the collector will be several times greater than the resistance change when the base is connected to the emitter.

One important question that must be answered is which resistance scale should be used. This depends entirely upon the voltage used by the ohmmeter and the internal resistance of the ohmmeter. The mid-scale resistance reading on the ohmmeter dial is the internal resistance of the ohmmeter circuit on that range. The maximum current will therefore be the battery voltage divided by this resistance. On most ohmmeters this is 1500 ohms on the times one hundred scale. This coupled with the almost standard 1½ volt battery means that no more than one milliampere of current can flow. Since even the lowest powered transistors are almost always rated at one milliampere at least, this means that R X 100 is the logical scale on which to start. It will be impossible to injure most transistors with one milliampere no matter how it is connected.

On germanium transistors, especially power transistors, it will probably be necessary to switch to a lower resistance scale to get a useable reading. Usually you need not worry about burning the transistor up with excessive current as power transistors are designed to stand far more than the 100 milliamperes or so of the normal ohmmeter on the R X 1 scale. On the other hand these new, small signal silicon transistors have such small leakage currents that it is often impossible to get any reading with the base open and using the R X 100 scale. This need not be a deterrent however, just go right ahead and touch the base lead to the collector, the ohmmeter should now read something downscale from the infinity mark indicating a good transistor. You can switch to a higher resistance scale, but care must be taken that the voltage ratings of the transistor will not be exceeded as normally a higher battery voltage is used on the higher resistance ranges.

Incidently almost all ohmmeters with the exception of the Simpson model 260 have their polarities reversed on ohms. That is, the black or common lead is tied to the positive side of the battery and the red lead is tied to the negative side of the battery. If you are in doubt as to your particular meter and do not have a separate meter to check, don't despair, just find an old diode that is marked and measure it's resistance. In one position the resistance will be low and in the other position the resistance will be high. The negative lead on your ohmmeter will be the one that is on the cathode of the diode when it is in the low-resistance position. The cathode end of a diode is usually marked with a black band. In any case it is the lead opposite the arrow in the diode symbol.

Fig. 4 shows the standardized lead configurations for most transistors. Unfortunately some transistors, especially the high power ones, do not follow a standard lead pattern.

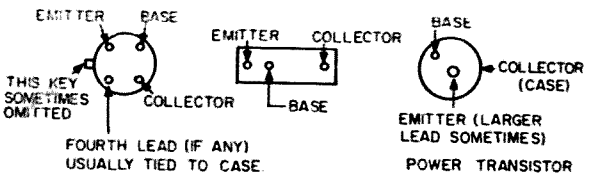


Fig. 4. Standard transistor lead configuration —all views of transistors from bottom.

Normally in these the collector is tied to the case and the larger of the two leads is the emitter. In case you cannot decide which lead is which, try the original ohmmeter test on the diodes. Measure the resistance between any two leads, reverse the leads and measure again. If there is a large difference in the readings, one of your transistor leads is the base. The lead that shows a difference in forward to backward resistance to both of the other leads is the base. The two leads that show no or the least difference are the collector and emitter.

By knowing which lead is the base you can try the other two leads both ways to see which polarity gives a resistance decrease when the base is connected to the negative terminal. Assuming that you are dealing with a PNP device (which will be true 99 and 44/100% of the time for commercial transistors) the collector is the lead tied to the negative terminal.

This method, while not the world's best, is probably the world's cheapest, especially if you already own an ohmmeter! It certainly is as good as these cheap transistor testers one sees flooding the market, and a good deal handier. You just have to know how to cheat.

I would like to thank Mr. Jerrold Ford for the original idea and Mr. Robert Atherton for his help.

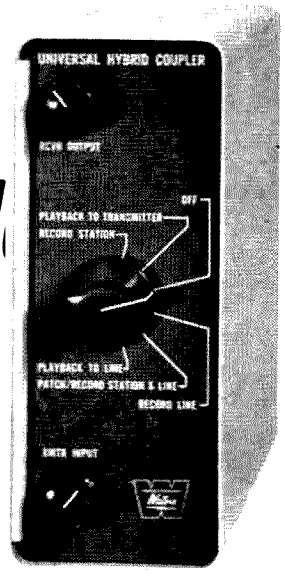
. . . W9QKC

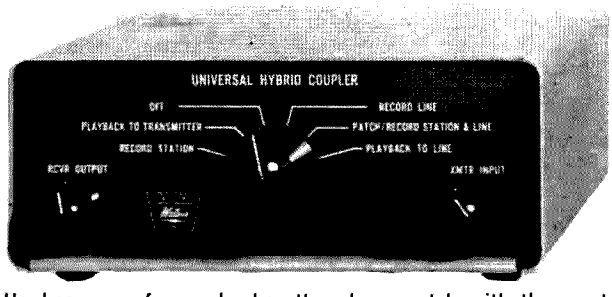
the HAM

the HAM what am buys his Waters Universal Hybrid Coupler at:

Evans Radio, Inc. P. O. Box 312, Concord, N. H.
The Lew Bonn Co. 1211 LaSalle Ave., Minneapolis 3, Minn.
Radio Shack Corp. 730 Commonwealth Ave., Boston 17, Mass.
Ft. Orange Dist. Co., Inc., 904-916 Broadway, Albany, N. Y.
DeMambro Radio Supply Co., Inc., 1095 Commonwealth Ave., Boston 15, Mass.
SREPCO, Inc., 314 Leo St., Dayton 4, Ohio
Hatry at Hartford, 100 High St., Hartford, Conn.
Custom Electronics, Inc., 1918 Brown St., Dayton 9, Ohio
Wackid Radio & Television Labs, 149 Gloucester St., Ottawa, Ont., Canada
Amateur Electronics, Inc., 2802 Ross Ave., Dallas, Texas
Harrison Radio Corp., 225 Greenwich St., New York 7, N. Y.
Newark Electronics Corp., 223 W. Madison St., Chicago 6, Ill.
Adirondack Radio Supply, 185-191 West Main St., Amsterdam, N. Y.
Southeast Audio Co., 1125 Rosselle St., Jacksonville, Fla.
Amateur Electronic Supply, 3832 West Lisbon Ave., Milwaukee 3, Wisc.
Electronic Wholesalers, Inc., 2345 Sherman Ave., N.W., Washington 1, D.C.
The Hargis Co., Inc., P. O. Box 526, Waco, Texas
Teletronic Supply Co., 3919-21 Montgomery Rd., Norwood, Cincinnati 12, Ohio
Universal Service, 114 North Third St., Columbus 15, Ohio
George D. Barbey Co., 333 N. 4th St., Reading, Pa.
Purchase Radio Supply, 327 East Hoover Ave., Ann Arbor, Mich.
Electronic Wholesalers, Inc., 9390 Northwest 27th Ave., Miami 47, Fla.

the HAM what am has a Waters Universal Hybrid Coupler.





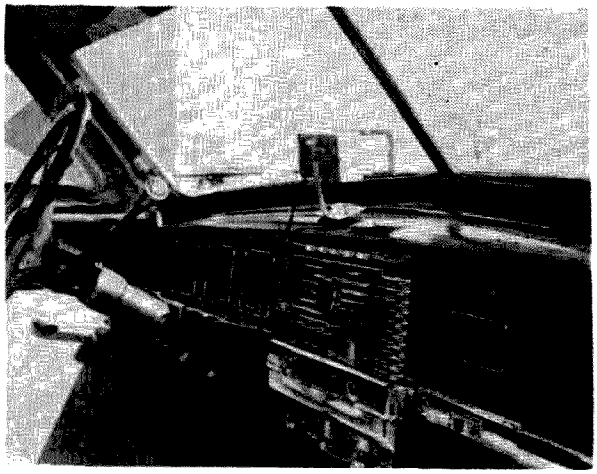
He has more fun . . . he has the phone patch with the most unique switch. Now for the first time: A tape recorder can be switched directly into phone patch conversations. Both sides of a QSO can be tape recorded.

With the Waters Universal Hybrid Coupler the tape recorder is now "an insider" and an integral part of your rig. The Waters Universal Hybrid Coupler not only performs as a phone patch but outpaces it by far.

This versatile network requires no power. A single 6-position switch controls all modes of operation including phone patch and tape recorder functions. No equipment changes needed for installation in any A.M. or single-sideband system.

The two-tone grey metallic case 6½" wide, 2 3/16" high, 8¾" deep, may be mounted either horizontally or vertically by reversing face plate. Theory of operation included with easy-to-follow installation and set-up instructions. Price $49.50.

WATERS MANUFACTURING, INC.
Wayland, Mass.



Paul Barton W6JAT
P. O. Box 1278
San José, California

Mobile 2.455 KMC Radar Receiver

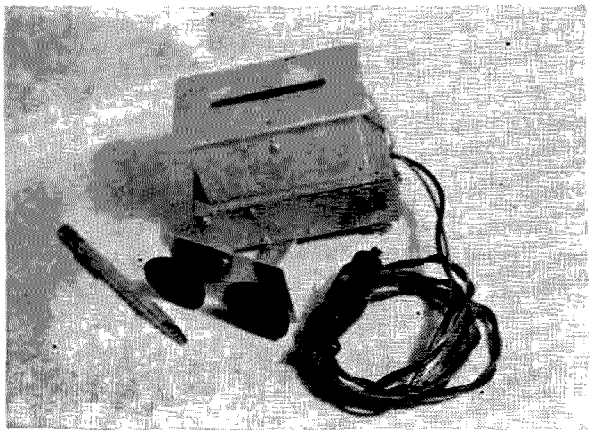
IN JANUARY 1958 issue of CQ, Don Stoner W6TNS, described a radar trap receiver. The receiver described here, is the same principle, but higher gain.

A slot antenna picks up the signal and transmits it into a piece of waveguide where it is detected to audio by a simple diode detector. The audio output of the detector is then amplified through a six stage high gain transistor audio amplifier, perhaps as much as one hundred DB, and fed into a one and one half inch PM speaker.

Only a modulated signal can be heard in the speaker, as no BFO or equal was put in this unit.

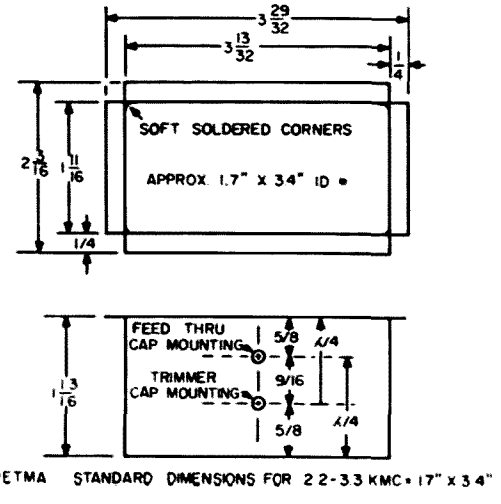
Military radars are normally modulated by their pulse repetition rate, and can be heard very well by this receiver. However, police radar is normally unmodulated. They depend on the doppler effect to give a tone proportional to the speed.

This tone will be equal to 86.4 times the speed in miles per hour, divided by the wavelength in centimeters. ($f_a = 86.4$ V)



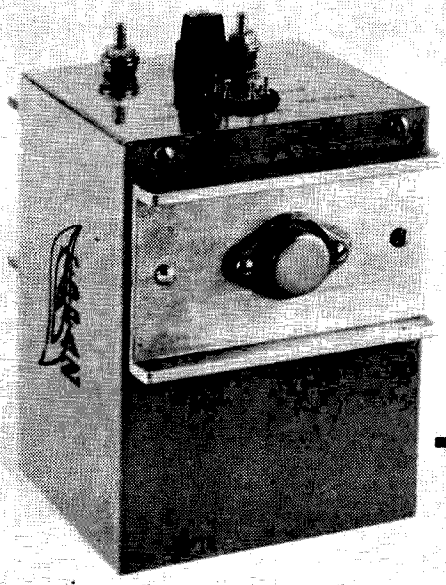
At 2.455 kmc and 60 mph the tone will be 440 cycles. So, if you hear a high tone in your radar trap receiver you are in the beam of a police radar and *going fast.*

The wave guide arrangement was designed by Ted Tillman K6AZU, Jennings Radio's VHF engineer. A small screw type trimmer capacitor is located down the waveguide a quarter wavelength from the slot (antenna). This trimmer then acts like an inductance in parallel with the slot, making it electrically shorter. So, the slot is made slightly longer than a half wave length and tuned in with the trimmer capacity. The diode detector is located in the waveguide a quarter wave from the back of the waveguide. The slot antenna is a half wavelength long, plus about 5%. These three dimensions, the spacing of the trimmer and the diode and the length of the slot, are the only critical dimensions in the waveguide. The cross section is not at all critical. If you



* RETMA STANDARD DIMENSIONS FOR 2.2-3.3 KMC = 1.7" X 3.4"

TOPAZ 250 WATT CONVERTERS



- Short circuit protected
- Compact — only 3 15/16" x 4 3/8" x 6 1/8"
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The Topaz C10W static converter operates the majority of mobile transmitters and receivers. Through new concepts in converter circuitry* this unit delivers more watts per dollar than any comparable unit. In addition, it is smaller and lighter in weight. Also it is higher in efficiency. This means increased savings through longer life of batteries and generators.

Its 120 volt, 400 CPS square wave accessory winding will operate various military surplus equipment. Also, this output can be readily rectified, filtered and used as a separate source of DC power. Space is provided for this feature on the printed circuit board. Diagrams are supplied so that the individual can supply his own rectification circuitry for a 120 volt DC bias supply.

specifications:

Model C10W

Input requirements: Voltage 11 - 15 VDC, 13 volts nominal

Outputs: *600 VDC (415 MA maximum)*
300 VDC (500 MA maximum)
120 VAC, 400 CPS square wave (bias or accessories - 50 VA maximum)

Efficiency: 85% *Fused*
Weight: approximately 7 lbs. *Power output: 250 watts*
Dimensions: 3 1/16" x 4 3/8" x 6 1/8"

note: Any combination of above outputs — up to 250 VA total maximum.

F.O.B. factory **MODEL C10W PRICE $79.50**

California Residents Add $3.18 Sales Tax. Enclose $2 for Insured Parcel Post Prepaid. No C.O.D. Orders.

The Model C10WG is similar to the Model C10W, but has an additional 0 - 120 VDC adjustable output. All other specifications are identical.

Outputs: *600 VDC (maximum 415 MA)*
300 VDC (maximum 500 MA)
0 - 120 VDC (plus or minus, 50 VA maximum)

F.O.B. factory **MODEL C10WG PRICE $89.50**

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*patent applied for

TOPAZ **TRANSFORMER PRODUCTS, INC.**

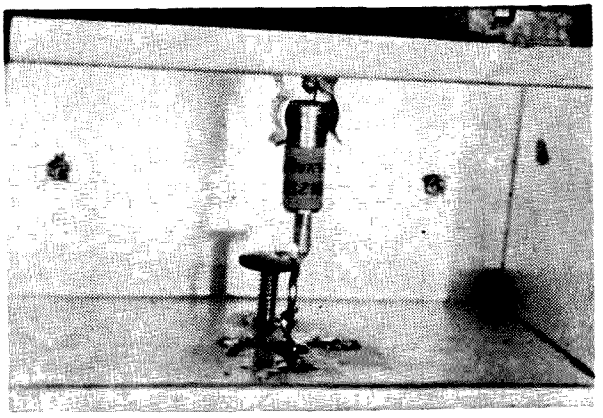
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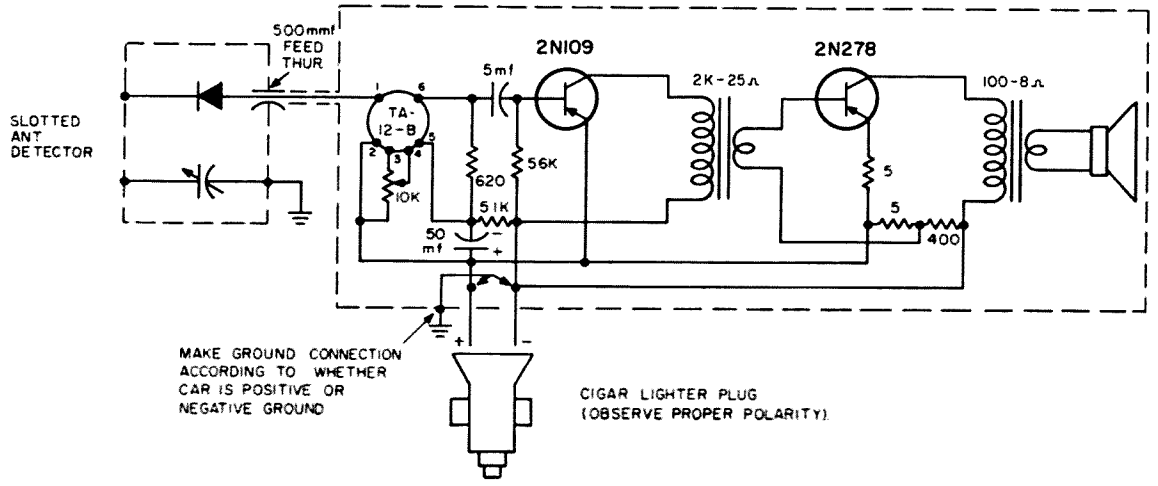
Available from local electronics distributor.

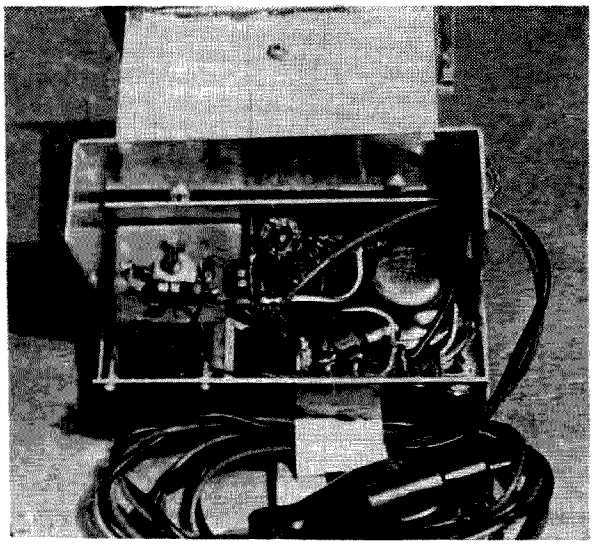
lay out a piece of .022 copper as shown in the stretchout, fold it and solder it, the dimensions will be close enough to work O.K.

The 1N21B detector mounting is a strictly off the cuff arrangement—quick, easy, and practical. A fancier arrangement could be made, but probably would work little better. The large end of the diode is gripped by a small fuse clip. The other end is gripped by a pin taken from an octal tube socket and soldered to the terminal of the feed through capacitor (see picture).

Police radar assignments are 2.455 kmc and 10.55 kmc. This unit is tuned to 2.455 kmc,







however the slide rule indicates that on 10.55 kmc, the slot is approximately four half wavelengths long, and the location of the diode and trimmer is approximately five quarter wavelengths. Thus this box can be expected to respond after a fashion on 10.55 kmc too. The size of the waveguide is not correct and the mechanical mounting of the diode is poor for this frequency though.

The police radar units send out (usually) a horizontally polarized signal. To receive horizontally polarized signals on a slot antenna, the slot should be vertical. In this case the unit is mounted on an arm so it can be turned either horizontal or vertical but is usually kept at 45 degrees to pick up either polarization, but with less sensitivity. The suction cups hold the unit in place on the dash, looking through the windshield.

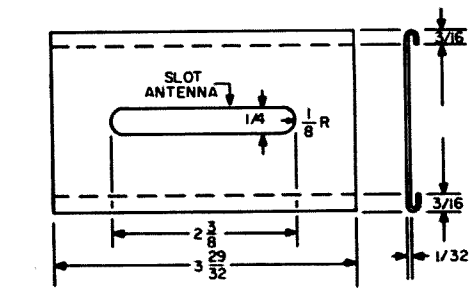
After the detector, the rest of the unit is a sensitive high gain transistor audio amplifier. In this case a centralab TA-12-B four stage pre amp was used, followed by a 2N109 transistor amplifier and a 2N278 power transistor output stage.

The amplifiers and speaker were "jammed" into a small California Chassis Company utility box 2-¼" x 1-¼" x 4-¼". The construction is non-critical. A pair of wires to a cigar lighter plug makes for quick installation. Polarity must be observed.

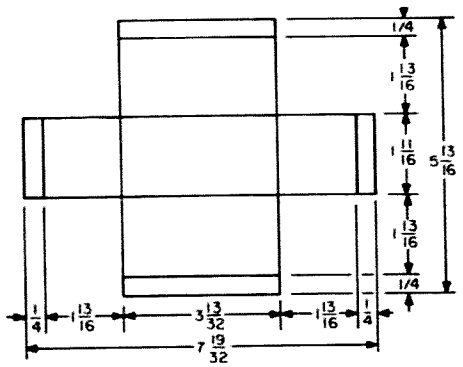
Provision was made to ground the case to either the positive or negative input lead to allow for either positive or negative ground in the car. This unit will operate on either 7.6 volts (6 volt system) or 15.2 volts (12 volt system). It works OK at reduced volume on 6 volts.

The 2N109 transistor stage is heavily biased causing severe harmonic distortion. This results in output in the speaker from lower audio frequencies than would normally be audible.

This speed trap receiver was built as a matter of interest. There is no real need for one in this area as speed traps are uncommon here. In fact, in six months time I still haven't found one to test the unit on so cannot report on the sensitivity of the unit. However, it should be quite sensitive as it receives military radar from Moffett field 20 miles away with ease. I wonder how many megawatts of power they run? . . . W6JAT



MATERIAL: .022 COPPER SHEET (SILVER PLATED)



1) NO ALLOWANCE FOR BENDS
2) MATERIAL; .022 SHEET COPPER, SILVER PLATED
3) FOLD, THEN SOFT SOLDER BOX CORNERS

Editor's Note

My great interest in the UHF's naturally caused me to invest in one of the "Radar Sentry" receivers when they first came out. Being interested in DX I now have one of their new improved models. I find it very fascinating to drive along and listen for radar signals from airports, planes, ships and OTHER sources. On the off chance that you, as amateurs, may be interested in listening in on the UHF's I am publishing this article on a home made receiver.

You may occasionally hear some of the police radar systems with this receiver. These are used for checking traffic speeds and will be of little or no interest to you. If you are interested in the equipment they are using you might slow down a bit just to see it as you pass.

Perhaps some of you UHF experimenters will come up with a small portable low powered transmitter for our 2500 mc band which can be used in the car to communicate with other amateurs who are monitoring this intriguing band.

. . . wayne

Melvin H. Shadbolt WØKYQ

Ham TV Survey 1962

Status of TV established in recent poll! Interesting facts revealed!

SHOULD there be ONE MC TV on the upper portions of 6 and 2 meters? Do you want a TV organization? Are you presently on television? Shall we have more articles on this subject?

Answers to questions like these have been coming in from all parts of the country as the result of our aJnuary nationwide Ham TV survey. Did you vote? (What about your local ham friend, did he vote?) There's still time! We want this to be as complete a survey as possible, including not only those fellows who are presently on television, but also those who are still in the planning stages.

This information will help us in several ways: (1) to reinforce present evidence that a majority of TV enthusiasts are in favor of petitioning the FCC for ONE MC TV in the upper portions of 6 and 2 meters. (2) To complete our listing of TV operators . . . a very important forerunner to the forming of a television organization. (3) To aid in determining the number of 73 readers interested in seeing more articles concerning this phase of ham radio.

So if you don't have your January issue handy, or simply don't care to cut it up, just jot down the answers to the above questions and send them to: 73 Magazine, 1379 East 15th St., Brooklyn 30, New York.

In the meantime however, we've received more than enough surveys to indicate very definite trends on the major issues. So in order to further analyze the results, as shown in the illustrations, let's take a close look at each issue separately and see what conclusions can be drawn.

One MC T Von 6 and 12 Meters

This undoubtedly was the most important issue and quite likely the one which created the most enthusiasm among amateurs who have been questioning the future of ham television. As you can see by the results shown, the "yes" votes were way out front with an 88.7% majority with only 5.6% against the issue and another 5.7% undecided pending further details.

QUESTION	YES	NO	UN-DECIDED
ONE MC TV ON 6&2	88.7%	5.6%	5.7%
ORGANIZATION	81%	5.5%	13.5%
MORE TV ARTICLES	94.4%	.8%	4.8%

The major question raised by those who voted against the ONE MC TV system, seemed to be: "What happens when the band opens, or when too many stations from any one particular area try to use the band at the same time . . . since at most, only a couple channels could be allowed on either 6 or 2 meters?"

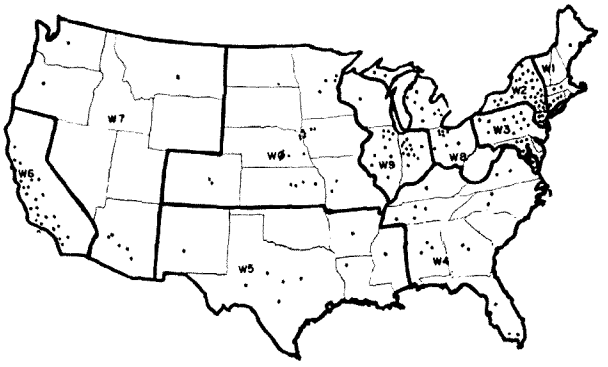
Actually, this is not as serious as it might first appear. After all, don't we presently have similar difficulties on our all ready well established AM and CW bands? Look at 75 meters in the evenings. Often it is so crowded as to be almost useless. Or take 15 meters for instance, during some skip conditions the band is so cluttered that it is nothing more than a mass heterodynes with only an occasional opening. Does this present a major crisis? Of course not, it simply means that if we can't successfully work out on one band we move to another.

As still a better example, take our present TV band, 420-450 mc, of which, by mutual agreement we are confined to the 436-450 mc portion . . . a mere 14 mc . . . which, although it may seem like a lot, often cannot accomodate as many stations in any one area as 2 one mc channels on 6 or 2 meters. The reasoning behind this is due to the fact that only vague bandpass limitations have been placed on TV operations in this band. Consequently, if an operator desires to transmit the somewhat normal wideband 4.5 mc signal, he has actually taken up a total of 9 mc . . . assuming the use of standard amplitude modulation techniques.

At present however, this band is of little value to a large portion of amateurs, since the distances which they must span are well beyond the normal capabilities of equipment operating on such high frequencies. (Observe Fig. 2.) Therefore, these fellows either loose interest or confine their operations to closed-circuit experimental work.

A 6 and 2 meter restricted bandpass system, on the other hand, could aid in closing this gap! Fellows in relatively inactive areas could begin transmitting over greater distances. As the activity increases (in any one area) or during skip conditions (when the lower bands become too crowded for satisfactory operation) it would be a simple matter of moving up to the next higher band. This would not only reduce the confusion of a congested band, but also promote the use of all our allotted frequencies as conditions permitted.

Besides, why shouldn't we be allowed the upper portions of these bands . . . they are presently being almost entirely rejected by the AM and CW fellows, and after all, look what happened to 11 meters through lack of activity! If we don't use 'em . . . we're sure to lose 'em!



It's a sure cinch that such a system, in addition to providing an operational band for many widely scattered enthusiasts, would also stimulate experimentations far beyond anything we have seen so far in this phase of amateur radio. New ideas and circuits, which are now being confined to basement experimenters, could finally be "air-tested"! A few of the possibilities quite likely to be at the top of the list might include such band-conserving projects as: (1) SSB-TV Vestigial sideband TV (the system used by broadcasters in which the bandpass is reduced by suppressing a portion of one sideband) (3) Different combinations of horizontal and vertical scanning rates (4) Various scanning processes such as interlaced scan, controlled random scan, spiral scan, etc.

Recently some very interesting and promising results have been obtained by various groups in such specialized scanning experiments. The goal, of course, is to develop a truly practical and economical system which would eventually require even less bandpass than the presently suggested system. What's really needed at this time however, is for us to get into the race with a ONE MC 6 and 2 meter system and show others that amateurs still have that old traditional pioneering and experimental spirit!

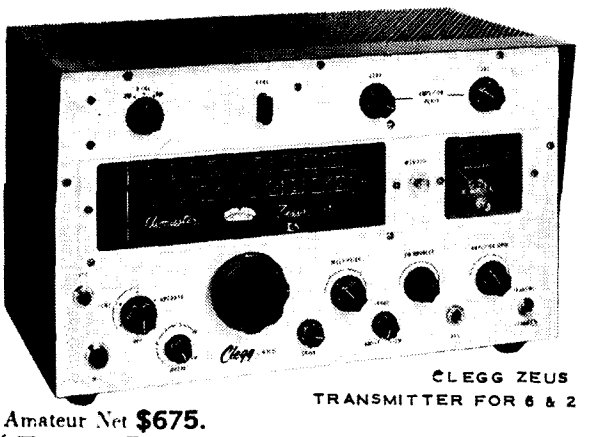
Some Sort of Organization Needed

This was also accepted with flying colors . . . with 81% voting "yes," and only 5.5% voting a definite "no". . . the remaining 13.5% remaining uncommitted pending furither details.

Now the question seems to be: How far shall we go for a start? It would appear to us after studying all of the surveys that we are not quite ready to form a full-fledged organization at this moment, however, we could be wrong.

Our decision lies in the fact that although some 81% voted "yes," only about 15% of these were presently on TV . . . the remainder still in either construction or planning stages. However, late voters may alter this figure considerably.

The desire for an organization seems to stem from the need to:



CLEGG ZEUS
TRANSMITTER FOR 6 & 2

Amateur Net **$675.**

"Loudest signal on the band!" . . . *yours with a Clegg VHF Transmitter*

Spectacular advances in the field of electronics in recent years are presenting outstanding opportunities to manufacturers and the serious VHF amateur alike.

Research and development at Clegg Laboratories have played a consistent role in the design and engineering of superior VHF equipment for the serious operators on these bands. From this continuing research have come such products as the Clegg ZEUS transmitter for 6 and 2 meters, the INTERCEPTOR VHF receiver, the 99'er transceiver for 6 meters, and the 2 x 4 audio oscillator.

Each of these units is outstanding in its field. The ZEUS, for example, provides 185 power-packed watts on both 6 and 2 meters. Automatic feedback control of low level speech clipping permits maximum talk power without splatter. The INTERCEPTOR receiver, using the latest nuvistors in r.f. stages, provides a noise figure of less than 2 db. and sensitivity of better than .25 microvolts.

The 99'er provides a complete VHF station for the ham with a limited budget.

Ask your distributor about these new Clegg VHF units today. Or write for complete information.

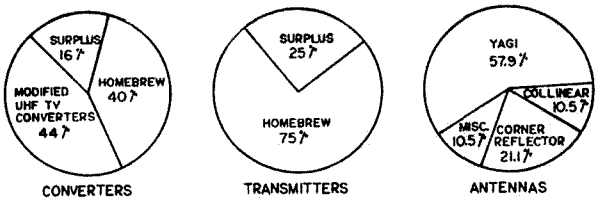
Clegg LABORATORIES

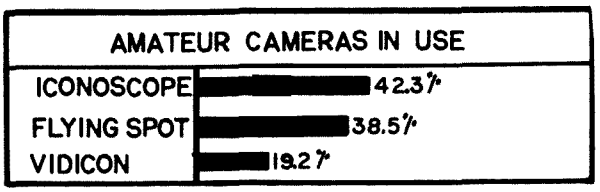
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CLEGG 99'ER
6 METER TRANSCEIVER





(1) keep in contact with fellow TV enthusiasts.
(2) establish a periodical bulletin which would include such things as a swap column, hints and kinks section, technical developments among members and specialized articles.
(3) join our efforts for more effective voicing of our opinions with regards to promotion of this phase of hamming, changes in allocations, etc.

Several fellows have offered their services in any manner in which they can be put to use. Any other volunteers . . . especially those with qualifications needed to form such an organization . . . it's a job for someone with a fair amount of time. How about some of you fellows who are partially retired??

In the meantime, until something more definite can be formulated, we are in the process of making up a small directory including the present status of all available amateurs who participated in the survey. Keep watching 73 for details on how to get your copy . . . these will be offered strictly for cost of printing and handling.

Cameras in Use

As can be seen from the diagram, it looks as though the flying spot scanner cameras and the old surplus converted iconoscopes are running nearly neck and neck in popularity; with the vidicon taking third place. No reports of anyone using image orthicon tubes as yet . . . probably due to their unattractive feature of "image burn-in," a problem that results when the camers is left focused on a subject for any length of time without being moved. Vidicons, fortunately do not inherit this bad feature and consequently are close contesters to the flying spot and iconoscope cameras. These tubes are evidently, for the most part, those discarded by local TV stations.

Taking all factors into consideration, the FSS seems to be the top favorite, especially among those first starting out in TV. This is probably largely due to its straightforward construction, ease of operation, and the requirement of almost nothing other than standard, readily available junk box components.

Vidicon interest should, on the other hand, continue to enjoy increasing popularity, especially as more and more discarded tubes become available to the fellows.

Article Interest

This was the last major issue covered in the survey with the requests for more TV articles (both of the construction and the basic theory type) running way out front with a 94.4% majority! Only .8% against and 4.8% not caring! Looks like we won this issue also . . . now all that is needed is some writers. According to the survey letters, at least one or two articles are in the developmental stages already.

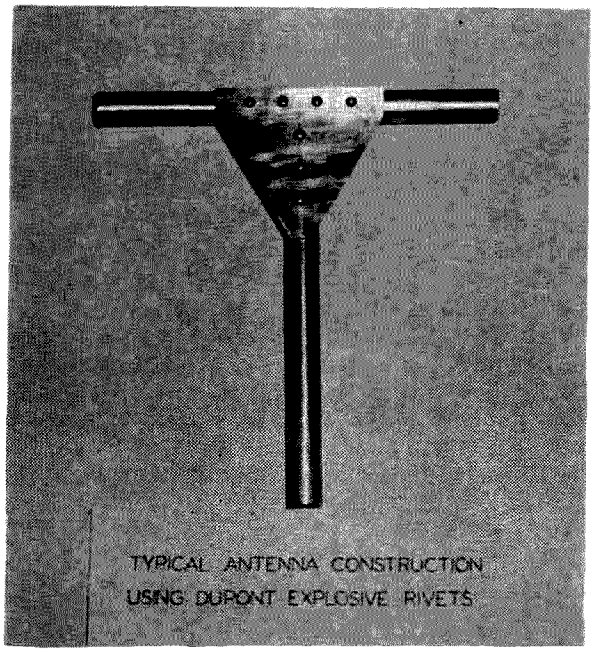
One thing we should keep in mind when submitting these articles is that over 80% of the individuals participating in the survey indicated they were still in the planning or early construction stages. A large majority of these fellows indicated a need for more basic understanding of the fundamental principles involved. So when submitting your articles, don't think entirely in terms of construction, alignment, and operation, but also include brief, but thorough explanations on how the equipment functions. This will often give a reader just the added confidence he needs to actually begin construction. Let's not promote "Black box" mystery projects!!

Blind Fasteners Aid Construction

Roy E. Pafenberg W4WKM

THE writer has a particular genius for maneuvering himself into an inextricable position in just about any field of endeavor. In the area of equipment construction, it is more a matter of wishful thinking than an ignorance of the electronic facts of life. In project after project, the attempt is made to construct equipment equal to or smaller in size than the cube of the component parts. Not the least of the problems encountered in this approach is the installation of nuts and washers on screws extending into inaccessible portions of the equipment.

It was, therefore, with a degree of elation that samples of the Du Pont expansion rivets were obtained. These one-piece fasteners appear to be conventional brazier or flat head aluminum rivets. The only distinguishing feature is the presence of a small chemical charge loaded in a cavity in the rivet shank. Application of the proper amount of heat to the head causes the chemical to expand the shank and to lock the rivet securely in place. No access to the back of the rivet is required at any



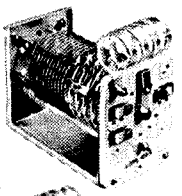
stage of the installation, making it ideal for those difficult assembly jobs. A neat, finished job results and the color coded, alodized finish is attractive enough for "as is" use in exposed locations.

Another amateur application of these fasteners is shown in the photograph. Antenna construction requires a strong and secure

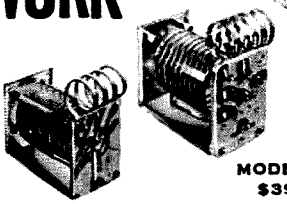
(Turn to page 26)

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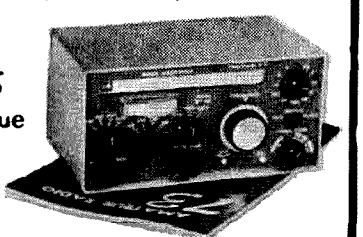
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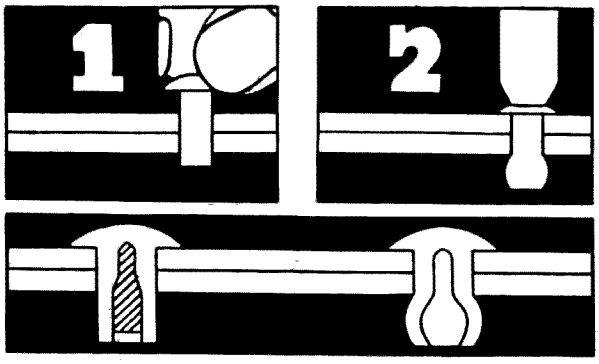
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Cross-section of Rivet before and after expansion.

means of assembly and through bolts are ruled out by the danger of collapsing the aluminum tubing normally used. The gusset plate and one wall of the tubing are drilled as a unit, with the rivets inserted as each hole is drilled. The rivets are then expanded, the assembly turned over, and the second gusset plate installed in the same manner.

While Du Pont does not recommend this, a standard electric soldering iron, not a gun, of 100 watt or higher capacity, may be used to expand the rivets. The copper bit should be reversed in the iron and the blunt end shaped to fit the rivet head. The drawing shows the details on inserting and expanding the rivets. Bit temperature is fairly critical and a Variac is suggested. In any event, the heat should be such as to expand the rivet in ½ to 4 seconds.

These rivets are available in a variety of styles, materials and sizes. The following list shows *some* of the sizes manufactured in the 56S aluminum alloy, modified brazier head type:

DU PONT TYPE	RIVET DIAM.	SHANK LENGTH	DRILL	WORK THICKNESS MIN.	WORK THICKNESS MAX.	COLOR
56S-134A-4	.134"	.150"	#29	up to	.045"	yellow
56S-134A-20	.134"	.310"	#29	.166"	.205"	blue
56S-134A-36	.134"	.470"	#29	.326"	.365"	black
56S-173A-8	.171"	.235"	#17	.025"	.085"	red
56S-173A-26	.171"	.415"	#17	.206"	.265"	black
56S-173A-38	.171"	.535"	#17	.326"	.385"	red
56S-204A-10	.202"	.290"	#6	.025"	.105"	blue
56S-204A-32	.202"	.510"	#6	.246"	.325"	brown
56S-204A-56	.202"	.750"	#6	.486"	.565"	black

The above list is by no means complete and is presented only to show the size range of these fasteners. Complete information, along with prices, may be obtained by writing Chemical Sales, Explosives Department, E. I. Du Pont de Nemours & Co., 350 Fifth Avenue, New York 1, N. Y. The biggest problem in the use of these rivets, from the amateurs point of view, is the fact that they are available only from the Du Pont outlets in minimum quantities of 100 each. Cost ranges from under $5.00 per hundred and up, depending on type and size.

These fasteners really work and their use will ease many difficult construction projects. If the cost seems high, have you recently priced high quality screws, nuts and washers?

Photograph and drawings courtesy of E. I. Du Pont de Nemours & Co.

The Half Wave Transmission Line

Mitchel Katz K2KPE

As most hams already know, a half wave line repeats the load impedance back towards the feed point at each half wave node when the line is terminated in its characteristic impedance. Using this information several ideas came to mind to facilitate antenna tuning and installation.

Before putting up a new antenna, measure the distance from the antenna site to the transmitter. Some rope, string, or scrap wire can be run over the final transmission line path to determine the length. Now calculate the transmission line length required so as to present a half wave multiple between the antenna site and the transmitter, for the lowest frequency band to be used. A half wave length of transmission line has a different length than a half wave of antenna wire in free space due to the velocity factor of the line. As coaxial cable using a Polyethylene dielectric has a velocity factor of .659 the following formula can be used to calculate the length of our half wave line. Length in feet, 492 multiplied by .66 and divided by Fmc. (324.72)

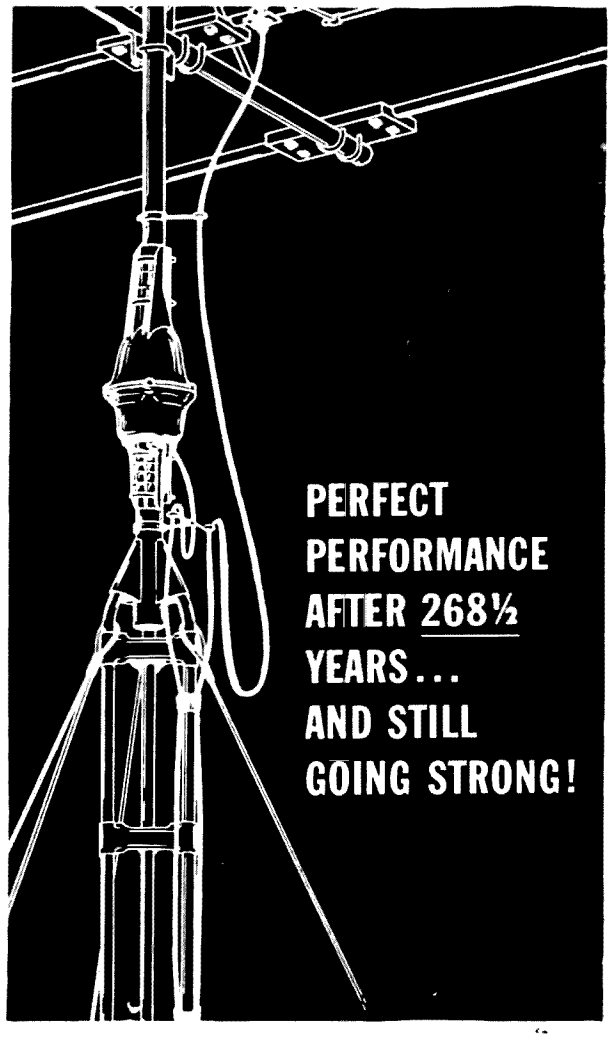
As an example, if we design a line for 7150 kc, using the formula we come up with 45.4

feet. This line then becomes 1 half wave at the design frequency. It is also 2 half waves at 14300 kc, 3 half waves at 21450 kc, and 4 half waves at 28600 kc. From the above it can be seen that if you cut a transmission line for the lowest band to be used it can also serve for other harmonically related bands. If we are primarily interested in 20 meter operation we could have designed the line for perhaps 14300 kc. This line would then figure out to 27.7 feet. Any multiple of the 27.7 could then be used between the transmitter and antenna.

Now for the actual installation. Measure the coaxial line so that you will have some full multiple of the half wave line between the antenna and the transmitter. Connect a suitable connector at one end of the line. Next cut off 10 feet of cable at the other end, and terminate these two ends with Amphenol type 83-1P male coax connectors. The other end of the 10 foot section can now be conveniently attached directly to the antenna proper. Both the main transmission line and the short sections, going to the antenna, can be joined by means of an 83-1J straight connector (female at both ends) and then taped over. If aluminum foil is wrapped around the fittings before taping they will stay bright and clean and will be well protected against the weather. In the future when you want to change the antenna, instead of removing the complete transmission line it is only necessary to replace the small 10 foot section, still maintaining our original half wave line length. If the transmission line you are using is much longer than the distance originally measured from the antenna to the transmitter, the coax may be coiled up at any convenient place, and tucked away out of sight.

Getting back to the half wave line, it is now possible to insert an SWR meter at the transmitter and know exactly what type of match we have between the transmission line and the remotely located antenna. Of course if the SWR is actually 1:1 then you would get the same meter reading on any length line. However if a mismatch does exist then by means of the half wave line you can ascertain the actual SWR of the antenna to transmission line.

If a spare line is built and kept coiled up, it can also be used for connecting a dummy antenna to the transmitter, still maintaining the proper SWR indication on a bridge. This may be important in tuning or aligning a transmitter. A 52 ohm dummy gave an SWR reading of 1:1 when connected directly to the terminals of an SWR meter. The same reading was obtained with the dummy load connected to the end of a half wave line. When intermediate line lengths were tried with the dummy, surprisingly large amounts of variation in the apparent SWR was indicated on the meter. . . . W2KPE



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50 MC
No Crossmodulation

Robert D. Grimm K6RNQ

2800 Monticello Avenue Oakland, California

How many times has your receiver been tied up in knots by strong local signals? If you are among the many that cringe whenever a rockcrusher comes on the air, weep no more; this converter may solve your problem.

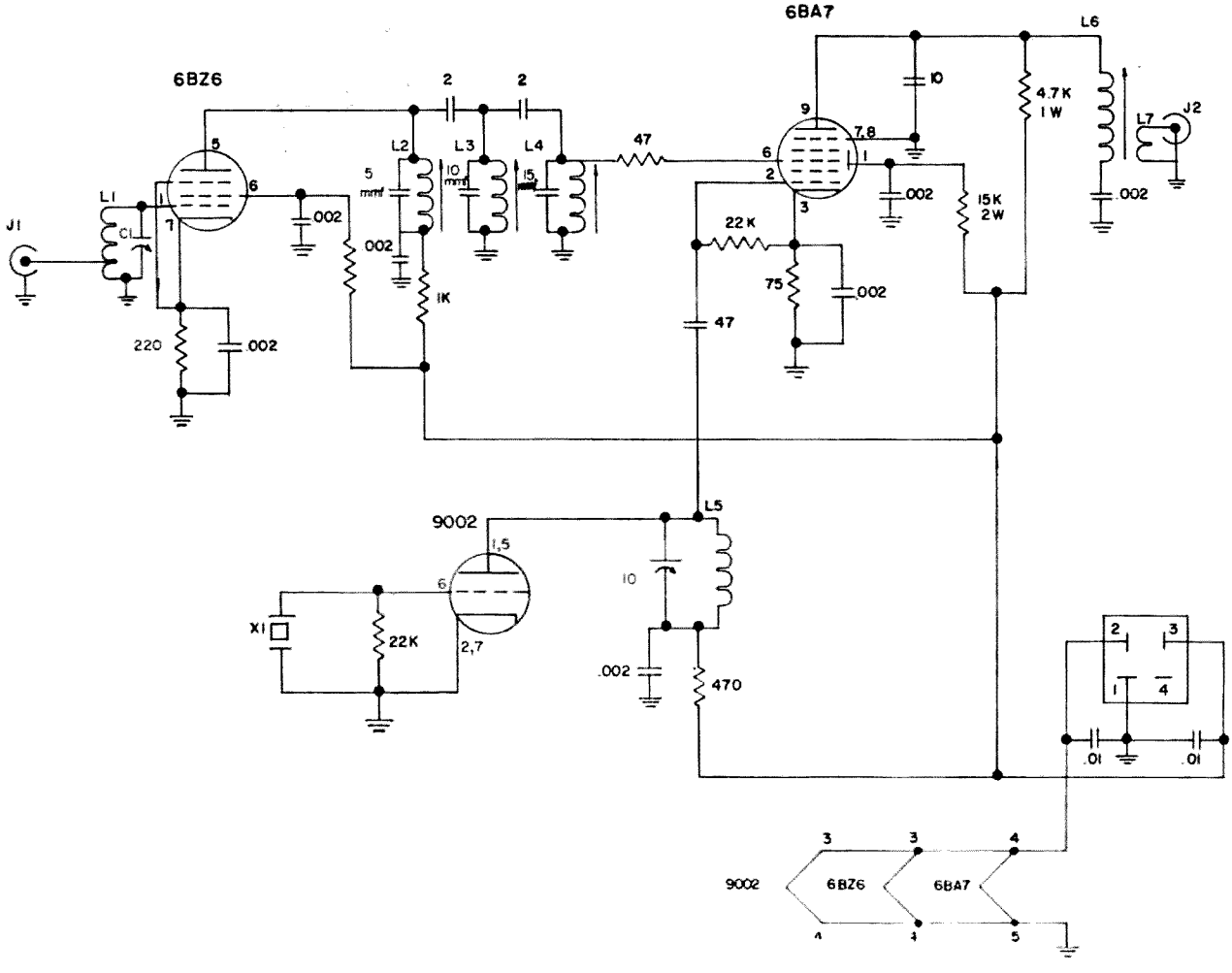
This crystal controlled converter was designed to handle extremely strong 50 mc signals without overloading. It has met that requirement quite well, while still maintaining a high degree of sensitivity along with adequate overall gain.

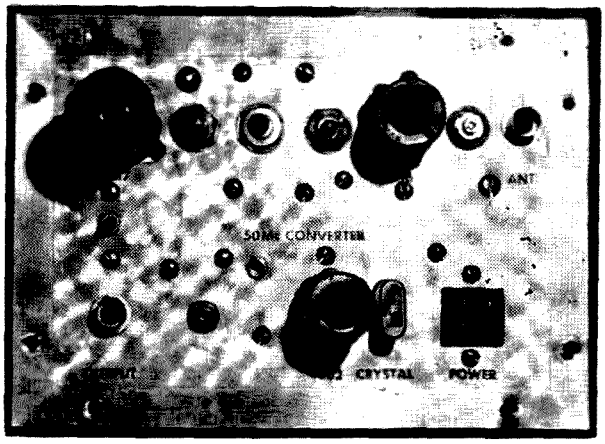
The heart of the converter is the mixer stage (this is where most cross modulation takes place), a 6BA7 pentagrid converter tube is used here. This tube was designed for converter service in the 88-108 mc fm band. It works quite well at 50 mc and its capability of handling strong signals without overloading is nothing short of phenomenal.

From the standpoint of noise one may question the use of a multigrid converter tube at vhf. While the noise level of the 6BA7 is greater than that of a triode mixer, it is still less than the atmospheric noise level at six meters. The only exception to this might be for that rare individual who lives out in the boondocks and who wouldn't have any worries about crossmodulation anyhow. While we are on the subject of multigrid converter tubes, the aforementioned statements about noise apply only to the 6BA7. They do not apply to the 6BE6 and 6SA7, which are inherently too noisy for vhf use. The determining factor in this matter is the ratio of plate current to screen current of the particular tube in question. This is the secret of the 6BA7.

Every effort was made to eliminate images and other spurious signals. To attain this end a high Q tank circuit was used in the grid of the 6BZ6 rf stage. A triple tuned bandpass circuit is used to couple the rf amplifier to the mixer. This triple tuned circuit provides excellent bandpass characteristics over the range of 50 to 54 mc and falls off steeply on either side. To assure the highest possible Q, silver plated, brass slug tuned coils were used in this circuit.

The *if* output coil is loaded by a 4.7 K swamping resistor, to make it broadly resonant over the 9 to 13 mc range. This tends to further enhance the overall bandpass characteris-

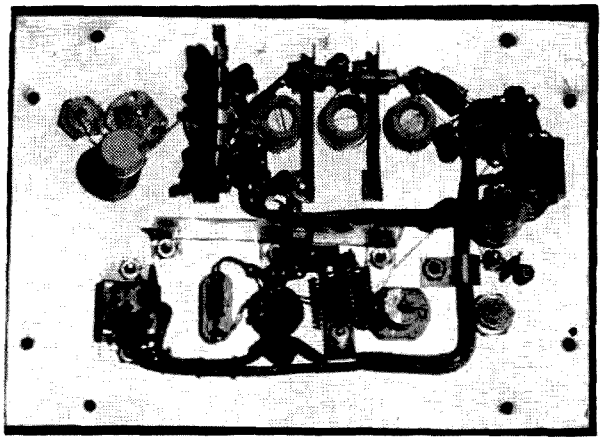




ties of the converter. The output of this coil is link coupled to the communications receiver through a length of coax to reduce the possibility of *if* pickup. If pickup of signals in the *if* range is a problem in your locale, it would be advantageous to use double shielded coax for this application.

A 9002 miniature triode is utilized in the oscillator (any triode may be used). This oscillator uses a 41 mc third overtone crystal in a conventional circuit. To obtain optimum performance the output of the oscillator should be adjusted so that 0.35 ma of injection current flows through the 6BA7 injection grid resistor. This may be measured by inserting an 0-1 dc milliameter with the 22 K grid leak resistor and the cathode of the 6BA7 mixer tube. The injection may be adjusted by varying the voltage to the oscillator or by varying the coupling to the mixer. Any greater amount of injection than the optimum value of 0.35 ma will only tend to increase the possibility of spurious responses and will not improve the performance of the converter.

The power leads are shielded and bypassed to further reduce the possibility of spurious responses and *if* feedthrough, as well as to eliminate a potential source of TVI.



All circuits are shielded from each other to prevent interaction and stray capacity coupling between stages. Copper shields are used between the individual coils in the triple tuned bandpass circuit to reduce the coupling between coils.

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The converter is constructed on a 5 x 7 inch aluminum plate. This plate is mounted on an inverted 5 x 7 x 2 inch chassis which serves as a case for the unit.

From the photos it will be noted that the aluminum plate sports a jewelers finish. This may be duplicated by placing a small piece of steel wool under your thumb and twisting it on the surface of the converter plate. With a little care and patience a very professional appearance may be had.

While this converter was designed for 50 mc there is no reason why it could not be used on 21 or 28 mc (by making the proper coil and crystal changes) with excellent results. . . . K6RNQ

Parts List

L1—10 turns #16 copper ½" diam., 1½" long.
L2, L3—8 turns #26 enamelled, closewound on ½" diam., brass slug tuned form.
L4—5 turns #26 enamelled, closewound on ½" diam., brass slug tuned form.
L5—8 turns B&W 3003 Miniductor.
L6—30 turns #30 d.c.c. closewound on ⅜" diam., iron slug tuned form.
L7—10 turns #24 enamelled, closewound at cold end of L6.
C1, C2—10 mmf. midget variable capacitor.
J1, J2—BNC type coax connectors, UG-1094/U.
X1—42 mc., third overtone crystal.

Page from a Designer's Notebook

Notes concerning the design of transistorized carbon microphone preamps

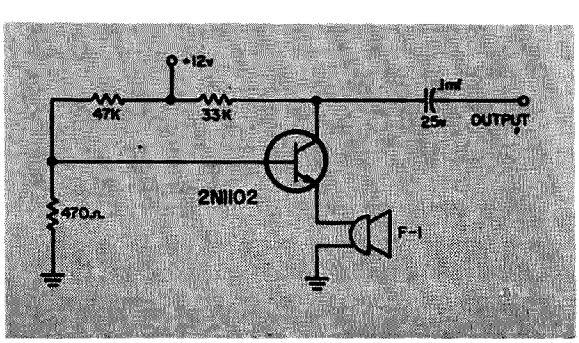
James L. Tonne W5SUC

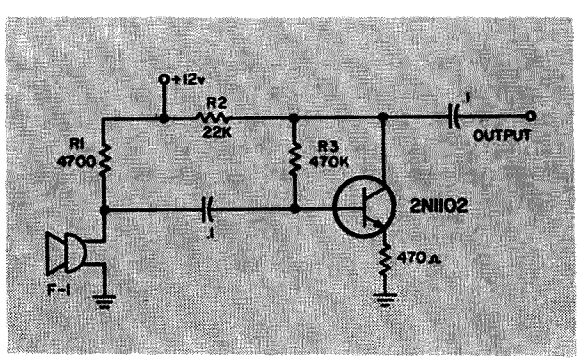
THE most logical approach to use in such an amplifier is to use a fixed bias on the base and insert the microphone in the emitter circuit. This circuit configuration corresponds to the grounded-grid tube circuit. This type of circuit (Fig. 1) is capable of good output and quality, and draws a very low value of current from the power supply.

If an additional current drain can be tolerated, a better circuit to use is a circuit wherein the microphone forms the grounded leg of a simple voltage divider from the power supply to ground, the output of the microphone then being sent on to an amplifier. It is found that this circuit (Fig. 2) has much more output and is more stable with regard to the position of the microphone than the "grounded base" arrangement. The voltage divider configuration is a bit more complex but has a much higher output. The output from the circuit can be controlled by adding an external resistance from the voltage divider to ground. The best place to add this external resistor is from the "supplying" resistor midpoint to ground. See Fig. 3. Alternatively, the output level can be controlled in steps by using a variety of resistors for the "supplying" resistor as in Fig. 4.

If the value of the load resistor is made large in the common-base configuration, in an attempt to get more voltage gain, the microphone current is reduced and the circuit output actually drops and in addition becomes highly nonlinear. But the load resistor for the separate-amplifier circuit can be of a high value to give good voltage gain, providing only that the transistor beta holds up at low values of collector current.

If a two-stage amplifier is used, it is not recommended that direct coupling be used between stages, since the average microphone resistance must be treated as a near-unknown. Such a circuit has been built (see Fig. 5) but it was only conditionally stable. Changing the position of the microphone sometimes caused severe distortion. This particular circuit did have a very high gain, however, and clipping was obtained even with low input levels.

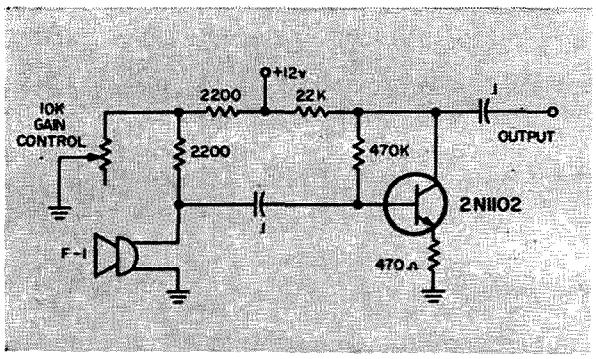


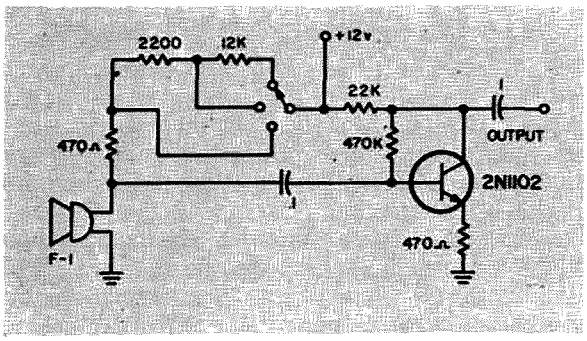


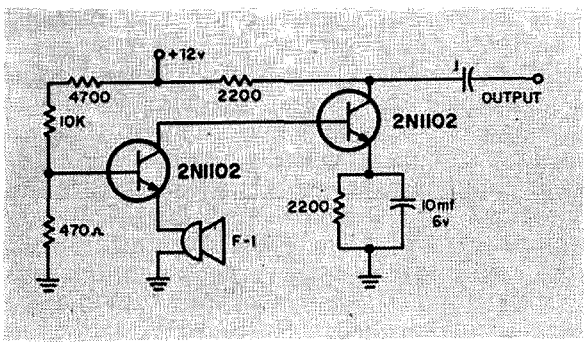
Under no conditions use a transistor as a mere current source for the microphone, and attempt to generate the output across some third element, such as a transformer. If the microphone resistance under static conditions drops to a low value, the collector current will soar. As an example of this don't, see Fig. 6.

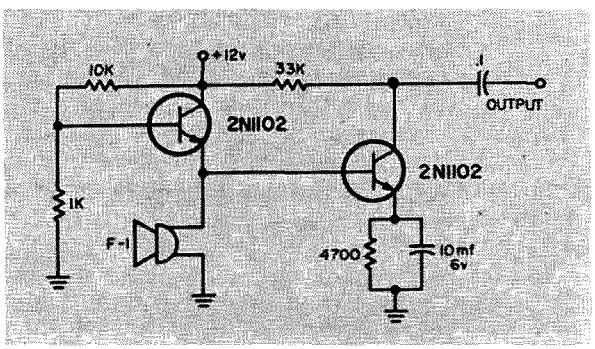
If it is possible to add the gain control at a later stage in the amplifier, then R_1 in Fig. 2 can be adjusted once and for all and forgotten. Lowering the value of this resistor will increase the output. Increasing it will decrease the output.

It should be pointed out that the high fre-









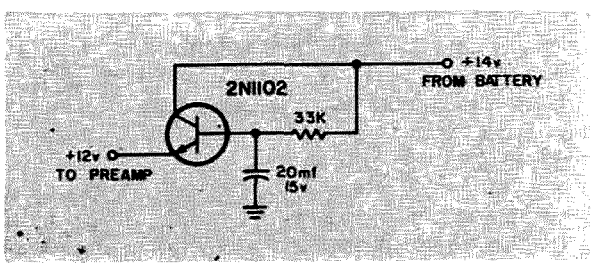
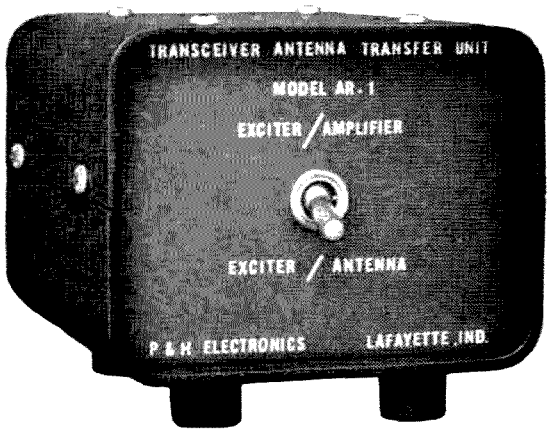


Fig. 7. A line filter to cut down on noise on the output which enters via the power source. The 33K resistor can be adjusted to adjust the output voltage.

NEW! from P&H

MODEL AR-1
TRANSCEIVER ANTENNA
TRANSFER UNIT



Here is the onswer to the problem of using your transceiver as an exciter for any linear amplifier. The AR-1 transfers the antenna to the transceiver while receiving and provides the necessary switching to connect the exciter to the amplifier, and the amplifier to the antenna when transmitting. A front panel switch also permits the exciter to operate straight through to the antenna. The relay is shock-mounted and the case is insulated to reduce noise. Standard SO239 connectors ore provided for low impedance coax lines.

LOW INSERTION LOSS: Transceiver output to amplifier input, less than 1.02:1 SWR, 3 to 30 Mc. Amplifier output to antenna, less than 1.12:1 SWR, 3 to 30 Mc.

The AR-1 requires 6.3VAC (6.3V jack on KWM-2) and normally open auxiliary contacts on the exciter relay. (ANT. RELAY jack on KWM-2). The AR-1 may also be used as a conventional antenna change-over relay. Size 3" X 4" X 4".

PRICE..... $32.50

P&H ELECTRONICS INC.
424 Columbia Lafayette, Ind.

quencies should not be filtered out by putting a condensor across the load resistor R_2 (in Fig. 2). If this is done, a severe distortion will occur at high input levels.

R_3 may need some adjustment if a transistor of unusually high beta is used. Simply adjust this resistor for symmetrical output on a scope at high signal levels.

Transistors of types 2N1059 and 2N1102 seem to work about the same. Type 2N679 seems to have a bit more gain, on the average.

The circuit of Fig. 2, then, is of reasonable simplicity, has about as much gain as most of the others, and is very stable. Output with a positive 12 volt supply is about 3 volts RMS. This circuit is to be highly recommended.

. . . W5SUC

James E. Ligon W4KOC
(ex K2AQN, F7BB, 3A2AQ)
2185 Hawthorne Street
Sarasota, Florida

To Brew or Buy

THE one question with which we amateurs are all faced at one time or another is whether to "home brew" or purchase a commercial rig. Now the purpose of this piece is to furnish some guidance in arriving at a satisfactory (at least to me) solution to the problem.

It is obvious that there is no simple answer —"one man's cup of tea is another man's poison" (or somewhat similar words to that general effect), but it is possible to provide some broad guide lines and perhaps recite a few personal experiences to assist in identifying and assembling the various facts which may have bearing on the problem.

In the first place, this somewhat unpleasant question was brought to me recently by my young son who spent the summer boning for his ticket. He has taken the examination and now must determine his equipment.

I explained that he must consider just what his own particular interests might be. It was pointed out that he would probably acquire a more solid theoretical basis for further pursuit of the hobby by constructing his own equipment, that he might take considerable pride in his accomplishments in putting a rig of his own construction on the air and that this would provide a valuable means of self-expression. On the other hand, most commercial equipment is expertly designed, efficient, has a low maintenance factor, is fairly priced, is immediately available and can be purchased on terms. His reply was to the effect, "Yeah, I know, but what do I do?"

It's like this. My first rig was a commercial job, but I really had no choice. You see, I was stationed overseas and in those days you just couldn't hardly get parts —. And then there was this fellow who was being rotated home—he had this equipment which he bought from his brother-in-law who is in the electronic supply business and he wanted to unload it before—.

My next rig consisted of a home brewed California KW which I bought from an impoverished W2 who was going SSB (or so he said). I never really had any trouble with it since I never got it on the air. My letters to him were returned and rumor has it that he was lost on a DXpedition.

I also tried my hand at constructing a "Sooper-Dooper Modulation Pooper," the details of which were contained in an issue of the ham publication "QRM." The article seemed to be clear and contained a list of components. Old W1 Ooble Ooble, the author, stated that he had found all the parts he needed in his junk box except for a few Fahnstock clips which he bought used from "Willy" in New York for two bits. I didn't have a junk box so I just clipped the parts list and sent it to "Willy" along with $59.95. (Just when was this you ask? You remember that your Mother was quite upset for a while after the $60 you were saving for a new bicycle disappeared? It was along about that time. And I must say that I'm proud of the way you pitched in mowing lawns, etc., to recoup the loss).—Construction of the "Pooper" was a cinch. It just didn't function. Six months later, "QRM" carried a short paragraph which indicated that resistor and capacitor values had somehow become confused with the blonde typist's telephone number. The paragraph indicated that this obvious error had, of course, been spotted and appropriate corrections made by the alert "QRM" readers. I never seemed to regain interest in construction of the "Pooper," particularly since about this time a standard transistorized production model became available for less than two dollars. The one I use now is the deluxe three dollar job which operates from 110-440 volts ac or dc, with multiplex outputs, covers the entire radio spectrum and has provisions for fuel injection.

My next project was the "Hi Q Squelch Meter." I found this a most rewarding operation. The meter works well even now. It is true that there is some question as to its actual necessity in operating the rig but you must admit that the visual red and green flashes and the intermittent high frequency buzzers which function nicely each time I receive a signal report of less than "50 db over 9" do aid in eliminating further contacts with rude and unqualified operators.

This should give you some food for thought and in conclusion, I can only say that it must be remembered that while my commercially engineered and installed equipment does operate with separate finals in all modes and at the maximum legal powers permitted in the amateur service, I am entitled to this since I have the money to pay for it and I have considerable amateur seniority.

Now, young Junior, you and your contemporaries are counselled to build your own equipment and keep your power at or below the Novice level until such time as you meet the Extra Class qualifications. This will insure not only your greater competency in the hobby but will reduce QRM for me and I like it that way. . . . W4KOC

500 Watt Linear Amplifier

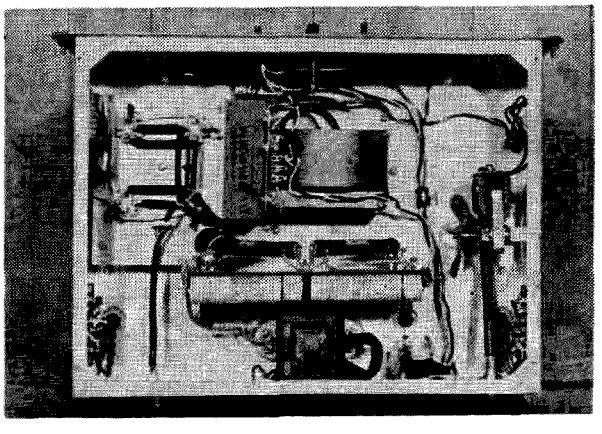
Louis Hutton WφRQF
2608 S. Fern
Wichita 17, Kansas

THIS unit was built as a power amplifier for my HT-37 exciter. It consists of four 811A's in grounded grid running 1400 volts at 300 ma. The external configuration was designed to match the HT-37, but still have some individuality. If the constructor does not rely on his junk box or surplus house as a source of low cost components, the amplifier will cost approximately $167. It took me about eight months to collect the major components and one month of lapsed time for construction.

Amplifier Construction

The amplifier was built on a 13 x 17 x 4 inch chassis, with a standard 19 x 10½ x ⅛ inch aluminum front panel. The four 811A's were mounted on a small sub-panel below the main chassis so that the tops of the tubes will clear the top of the cabinet by a safe margin. The 866A sockets were salvaged from the AN/APX-6 modification project. The insulating panel which mounts the four filter capacitors and two bleeder resistors was also salvaged from that project. The 10 meter coil section of the B&W coil switching assembly was rotated 180° to make for shorter lead lengths. A sixth band switch position is available on the B&W assembly and was used to provide an additional 100 mmfd of load padding capacity on the 80 meter band. Duplicates of the existing wiper contacts were made from .006 brass shimstock and are fastened by small bolts and nuts thru existing holes in the insulated back plate of the coil assembly.

When the unit was first tested for parasitics, it took off like a typical MOPA. This was cured by connecting the ground return of the



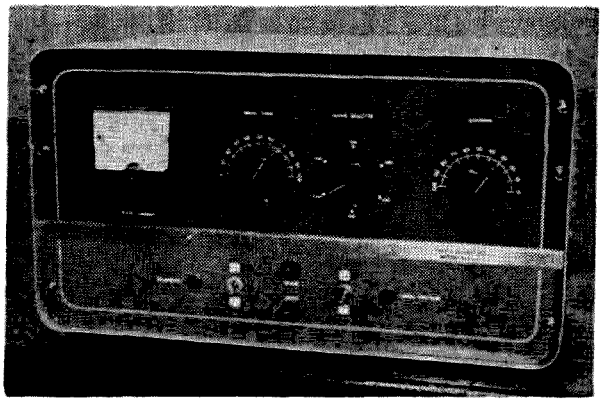


plate rf choke bypass condenser to the same ground point of the plate tank tuning condenser and changing the parastic choke coil from 3 turns to 5 turns across the 100 ohm resistors. The bias battery was added after testing to provide for more linear and cooler operation. The static plate current was 55 millamperes and the amplifier is loaded to 300 millamperes under the single tone condition. Using my HT-37 as a driver, the power output is sufficient to light a 300 watt dummy light bulb load to full brilliancy with excellent linearity.

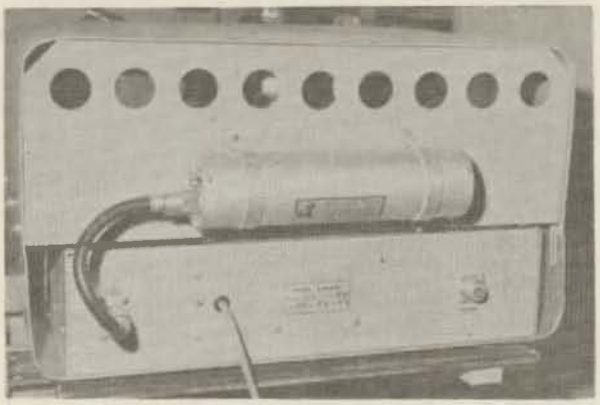
Cabinet Construction

After all the holes have been located and drilled on the grey hammer tone front panel, the corners are rounded off using a jig saw. Paraffin was applied to the blade to make cutting of the thick panel easier. The panel was then sprayed with two coats of Krylon #1605 Dove Grey spray enamel. A one-eighth inch width strip of masking tape was taped to the panel, marking out the border. The panel was then given two coats of Krylon #1604 Light Grey enamel. The lower half of the panel was then masked off and the top half sprayed with Krylon #1502 Flat Black. When the paint dried, the masking was removed revealing a three toned front panel. Decals were used for dial scales and lettering. Dummy relay rack panel screws, cup washers, and nuts were used to fill up the panel notches. The brushed aluminum trim strip was made from cabinet top metal trim.

The cabinet was formed from two pieces of .040-52S0 aluminum. The rounded corners were formed by manually bending the metal around

a 1½ inch diameter 3 foot length of thin wall conduit that was fastened to the edge of my work bench by "C" clamps. Two small pieces of scrap aluminum sheet were placed under the pipe before clamping to provide a slot between the pipe and the work bench.

The aluminum sheet was then slipped through this slot on to the bench of the proper depth, and the protruding part was bent upward, thus forming the rounded corners. The top half of the cabinet was attached to the bottom half by sheet metal screws. The screws pass through holes drilled in the upper section into a metal strip that is riveted to the inside



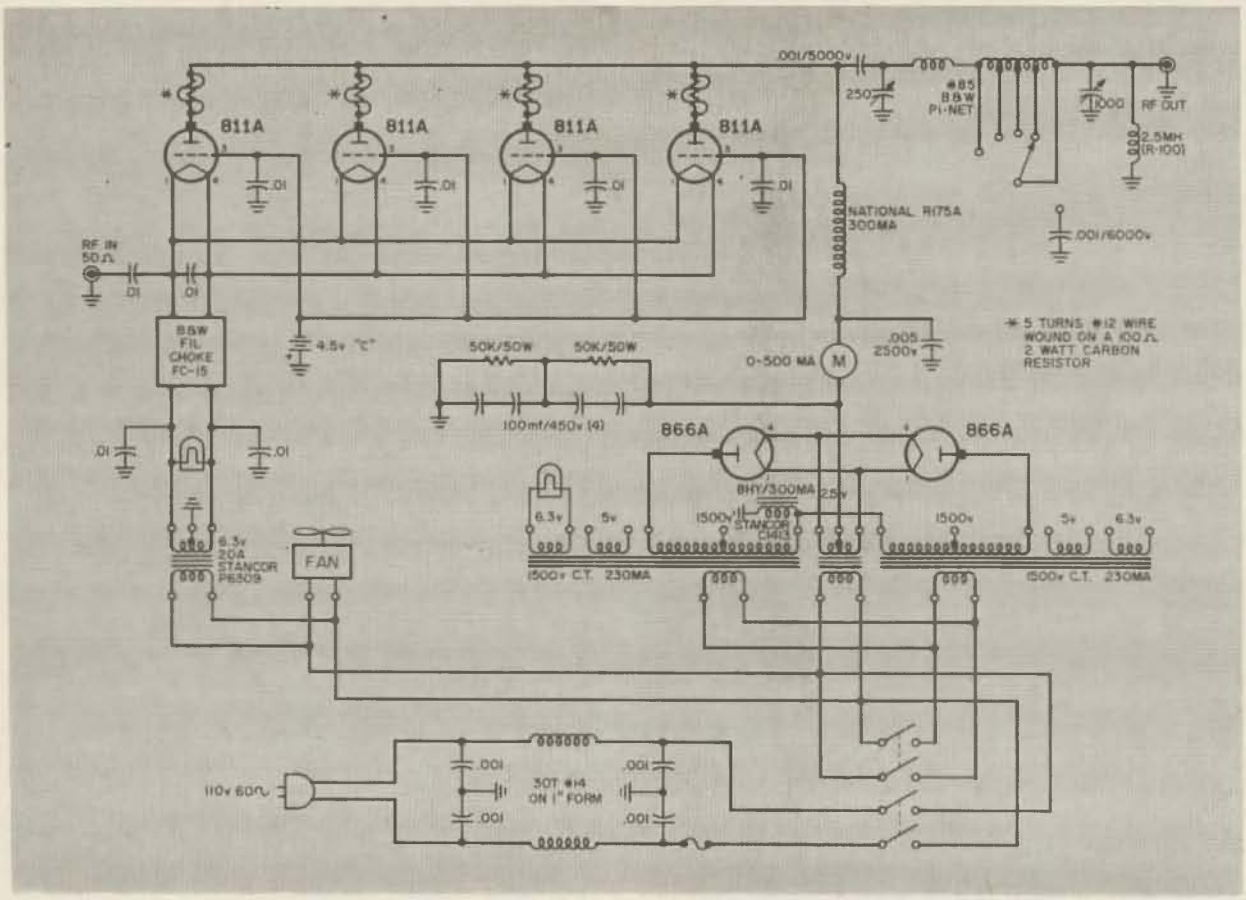
of the lower section. Two ventilation holes were cut in the top of the cabinet, one over the 811A's and the other over the 866A's. The ventilation holes were covered with grills made from Reynolds do-it-yourself perforated aluminum stock (cane bottom perforations). They are hand formed so as to fit flush with the top surface of the cabinet. When the sheet metal work was finished, I steel wooled the cabinet, then washed it in hot sudsy detergent soap to clean off all the grease and oil. This helps the paint adhere to the metal. It was then sprayed with 3 coats of Krylon #1605 Dove Gray paint.



This linear amplifier has received excellent reports from on the air operation, and from those who have visually examined the equipment. . . .WφRQF

Parts

Power Transformers:: McGee Radio Company. 1901 McGee Street, Kansas City 8, Mo. part number 949231. Fan: 4" blade. Olson Electronics,, 260 S. Forge St., Akron 8, Ohio. Part number MO-48.



Bob Baird W7CSD
3740 Summers Lane
Klammath Falls, Oregon

How to Build a Ham Shack

or

The String's the Thing

THE average ham or audiophile, or any other kind of hobbyist for that matter, has a limited amount of money to spend on his hobby. The thought of spending any vast outlay to house this hobby is something we instinctively avoid. At W7CSD there was a nine foot square space under a gable in the roof which was unfinished. A quick estimate of materials to finish and insulate this area ran into three figures. This was prohibitive if we expected to spend anything on ham radio. So a cheaper yet respectable looking job had to be devised. This article describes one method which is not 100 percent beautiful, but it doesn't look too bad and it is cheap.

Original Condition

The space had a sub floor and wall studs on all sides and there was a hinged door at the entrance. The gabled end had a window in it. Electrical power was easily available.

Walls and Ceiling

The first problem was insulation. Obviously a rock wool blanket neatly stapled between the studs would be ideal, but not for free. With a little reflection one will recognize that dead air is the all important part of insulation. So we merely nailed some heavy cardboard over the back sides of the studs and broke up the vertical circulation with cross pieces placed horizontally between the studs at frequent intervals.

The internal walls and ceiling are likewise made of cardboard nailed on the inside of the studs and rafters. Our source of cardboard in large pieces was an appliance store that sold refrigerators. Three or four of these giant cartons will do the whole job.

At this point in construction, your room will not be a thing of beauty and a joy forever. Cardboard does not lend itself to making clean neat perfect fitting joints. We fairly well solved this problem with wall paper paste and strips of muslin. Wall paper or wheat paste is readily available from any hardware or building supply store for a few cents. We mixed this with water and applied it to the seams with an old paint brush and then applied the muslin strips, painting on another layer of paste on the outside. The muslin was procured from an old bed sheet. The results at this point are shown in Fig. 1. A couple of coats of Kem-Tone or other water base paint on top of all of

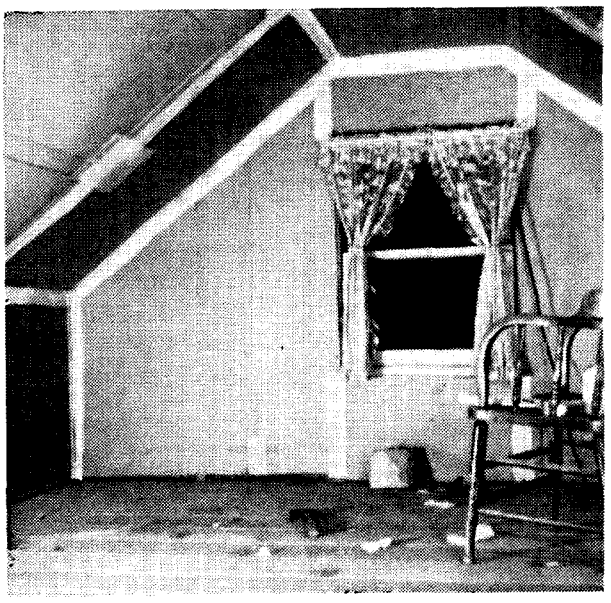
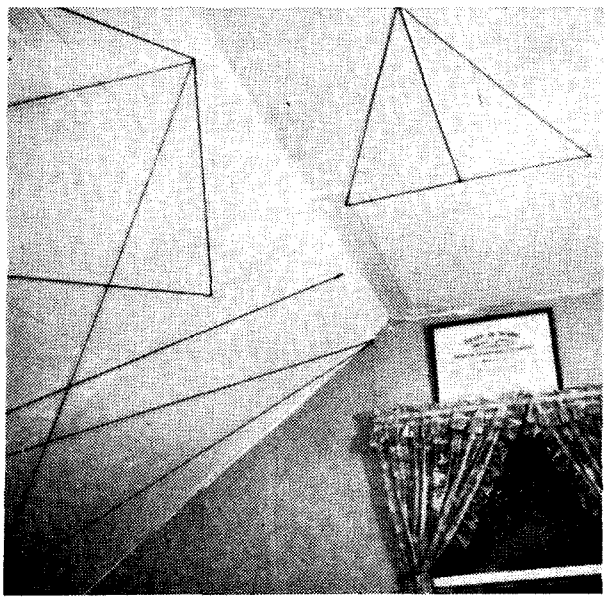
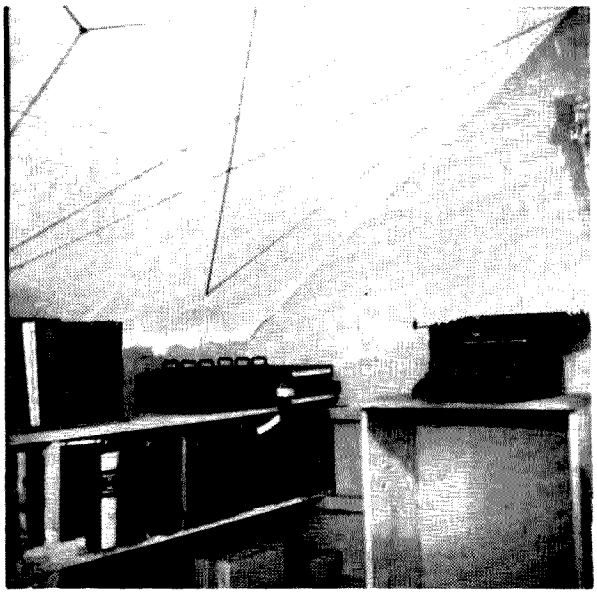
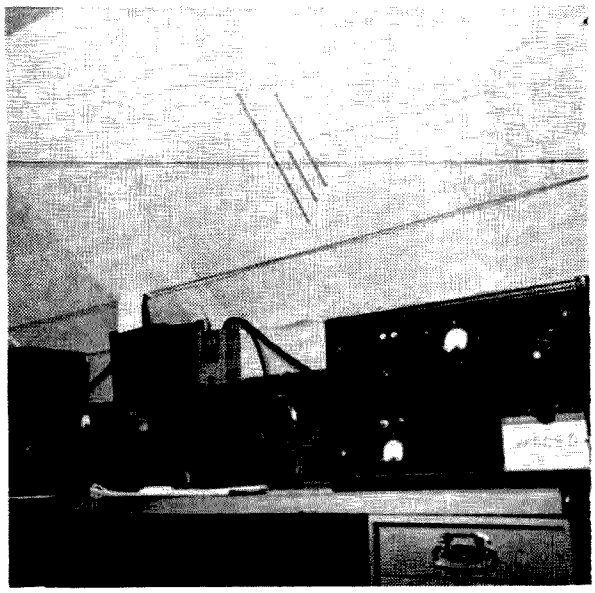


Figure 1. Walls after cardboard and muslin have been applied.



Bright red string makes an interesting distraction from the cardboard walls and ceiling.





A door makes a fine operating desk.

this makes things begin to look respectable.

There seems to be no way to get a good floor for free. We paid real money for enough quarter inch masonite to cover the floor satisfactorily. Some mop board was scrounged from a bargain basement scrap pile and our room, as such, was about finished.

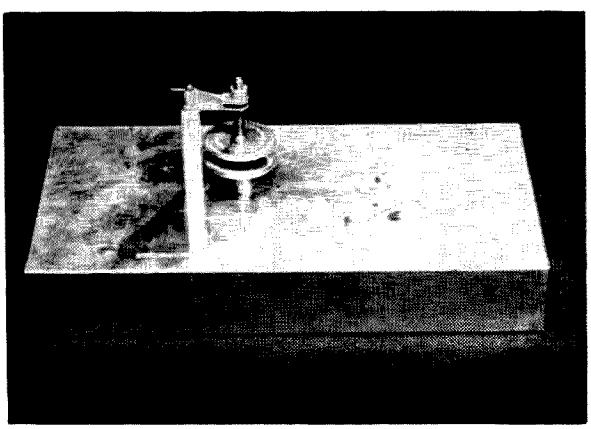
It was necessary to buy some good lumber for book shelves and a typewriter table. The table holding the ham equipment was made from a blank Philippine mahogany door. If you can find one of these damaged on one side you can usually get it for about half price. The steel drawers were also purchased and serve as one leg to the table. The rest is wall supported.

You can't get everything for nothing. And although the room at this point was fairly presentable the material used and many seams were quite obvious. It was decided that we would devise some kind of scheme to divert the attention of any visitor from some of the shortcomings of our construction. So we bought a hundred feet of hard wrapped twine, chalk line is very good, and a package of red dye. We unwound the twine and dunked it in the bright red dye and came out with some nice bright red twine. This we arranged in abstract designs over the walls and ceiling. Some of these are illustrated in the accompanying photos. It should be pointed out that taking pictures of the inside of a nine foot room from the inside of a nine foot room is somewhat of a problem for the casual shutterbug. We hope the general idea is conveyed. In any event brightly colored twine can be arranged in the abstract, in geometric designs, or in parts of a schematic diagram. Any or all of these give a novel setting to the cheaply constructed room and tend to camouflage the imperfections.

. . . W7CSD

Component Mounting Technique

Many electronic components are supplied with a mounting base to which the various parts are secured. While this design permits factory assembly and packaging as a single item, it often does not provide optimum performance. This is particularly true of RF components used at the higher frequencies.



It is sometimes possible to discard the mounting base and achieve better layout. An example is shown in the photograph. The neutralizing capacitor, as supplied, requires three holes to mount the base and a fourth hole to provide clearance for the grid lead. Discarding the base and mounting the bottom plate on a feed-through insulator permits installation using only two holes. A neater job results and better circuit isolation is provided.

Consider each component mounting problem carefully with the objectives of conserving space and improving efficiency. Many other components, such as rf chokes, lend themselves to this treatment and the same advantages accrue.

. . . W4WKM

Photo Credit: Morgan S. Gassman, Jr.

A Nostalgic V-Beam

Frederick Haines W2RWJ

BACK in the old days (just after the war), the beginning young op just couldn't afford to run out and purchase a "ready-made" rotating beam. For one thing there was only one make on the market, and for another it was just too much money! Some folks just up and built their own too, but aluminum tubing was practically unheard of yet, and the favorite method of construction was to use a 200 pound painter's ladder as the boom. These light-weight marvels worked out fine, but most of the boys didn't have the required 50 foot rigging crane to lift them up on the roof. As a result most everyone was content to use a half-wave dipole on the twenty meter band. I wasn't.

Slowly it took shape and after a long time bubbling beneath the surface, it broke through! Surely the only kind of antenna capable of excellent results isn't the rotating Yagi beam. Well, what was it to be then? 8JK's were in use, lazy H's weren't unheard of, and some of the more ambitious actually had erected Sterba Curtains and Bruce arrays. Somehow none of these appealed to me, I think because they all exhibit too much directivity, and would therefore not be much good unless rotatable, Heaven forbid! The die was cast, and a V-BEAM hit the drawing board.

As I reminisce, it's hard to keep from chuckling over the elaborate construction methods and over-design that were employed, and it's always a source of amazement to consider the perseverance and unlimited energy of the young.

The overall dimensions of the monster were staggering to behold. Each leg of the V was 272 feet long, the included angle between them 37°. Average height above terrain was the minimum recommended for good results, approximately ½ wavelength at 14.250 mc, which came out in the neighborhood of 34 feet. The theoretical gain over a half-wave dipole in the favored directions was about 10 db.

The feed system employed was a conversation piece for area residents and other hams for years, not because of technical oddity, but because of its length and appearance. The main portion of the array was mounted upon three 34 foot towers of wood. Each of these edifices was made of two 16 foot 4x4's, connected together by screwing four pieces of ½" thick hardwood about 2 feet long so they lapped halfway onto each 4x4, and on all four sides. Of course only non-rust brass screws were used throughout! At this point the three behemoth towers were lying side by side on nine specially constructed sawhorses receiving their three coats of aluminum paint. The area residents were only dimly suspecting that a change in the landscape was imminent; their interest was mild.

Holes were drilled to pass eyebolts arranged to attach wires and insulators, guys and pulleys. Simultaneously, three 3 foot deep holes were surveyed (a good trick in itself) and dug. Concrete and gravel were ordered and dumped near each tower location. Two 2x4's were set in each hole and bonded in concrete, spaced apart to allow the 4x4 towers to be bolted between them. Three iron stakes were also set in concrete around each tower location to hold the guys.

Then came the day of days! With the help of three friendly neighbors, the towers were bolted into their mountings and pulled skyward by the guy wires. One fellow manned the level, two others steadied, while I scurried about attaching guys and adjusting the turnbuckles for the exact tension deemed necessary. Then we stood back about ¼ mile and surveyed our handiwork. Without question it was the most remarkable sight we had seen in years!

After the ladder work was over and the wires were hung with care on those nice big fat ceramic insulators, the two acre plot looked suspiciously like a transatlantic broadcast installation on Long Island. Then came the feedline into the shack. . . .

Open wire 600-ohm feedline was used, and all 150 feet of it carefully hand fabricated using ceramic insulators and wire ties. A quarter wave shorted matching stub was run down the apex tower and the feedline attached. From there it ran over a series of 15 foot "telephone poles" to support its weight to the house roof. Over the roof and through feedthrough insulators, it went. In the shack it terminated in an antenna tuner, fed by the 100 watt 20 meter phone rig.

To insure proper adjustment of the feedline on the quarter wave stub, a 600-ohm open line "twin lamp" was made and the stub adjusted until the outgoing light was brightest and the reflected power light went out. This, incidentally works very well, although I don't think I've ever seen the "twin lamp" written up for

open wire lines.

With 80 to 100 watts input on the crowded 20 meter phone band 25 countries were worked in Europe, Africa, and the Pacific in less than 24 hours continuous time, spread out over a 6 month period. Some real juicy ones too. It was found that stations could be worked in any direction due to the many minor radiation lobes characteristic of the V, but of course extraordinary signal reports were only received in the favorable directions. In fact, many times, when working rare DX, I was reportedly "the only W on the band today."

All good things come to an end and so it was with my monster. For three years I enjoyed that notoriety which is afforded only those hams with antenna farms. None in the entire Central New York State Region had the slightest difficulty finding my house. Once in the neighborhood, one had only to ask about a large antenna and directions were immediately forthcoming. Then came the day I took a job in a far away city, and my long suffering mother, who is the real martyr of my story, suggested that perhaps I could take down the array? With heavy heart and almost reconsidering that new job, I agreed. Down it would have to come.

Ah, what a fate, to end up as a wooden border for a new flower garden, but that's what happened. The four by fours to this day keep the grass from encroaching on the flowers in the back yard. The concrete bases were just too much to consider moving and still are known to break cutter bar knives of unwary farmers cutting hay on the old antenna farm.

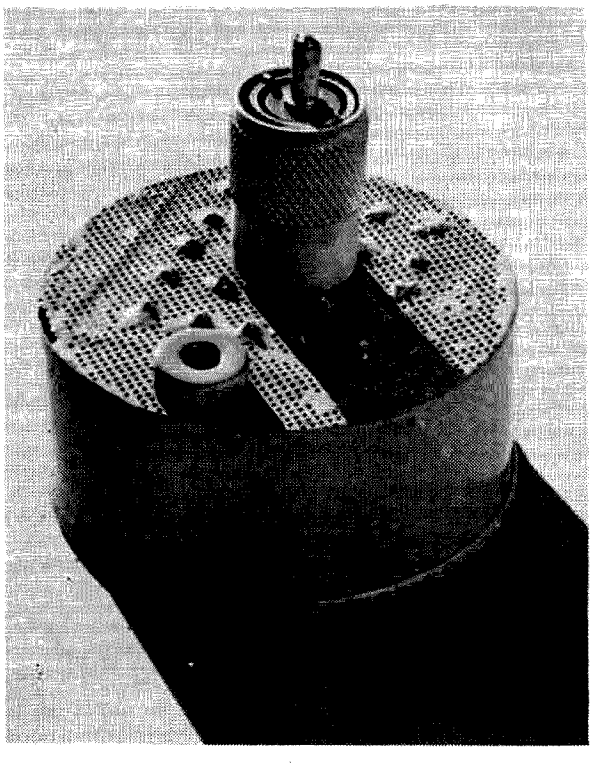
With the demise of that great old antenna, it was as if an era had ended for Ham Radio, and indeed it had, for it was just about that time that the trend toward store bought gear and ready made beams was established. Today if an antenna is much larger than a bread box, it's no good. I'd like to see a trend toward more of the large old wire antennas such as this one. Think it over, they really work out fine!

. . . W2RWJ

The Tiny Terminator

Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

HAVE you ever felt the need for a dummy load which would also indicate accurately the actual rf output power of a transmitter?



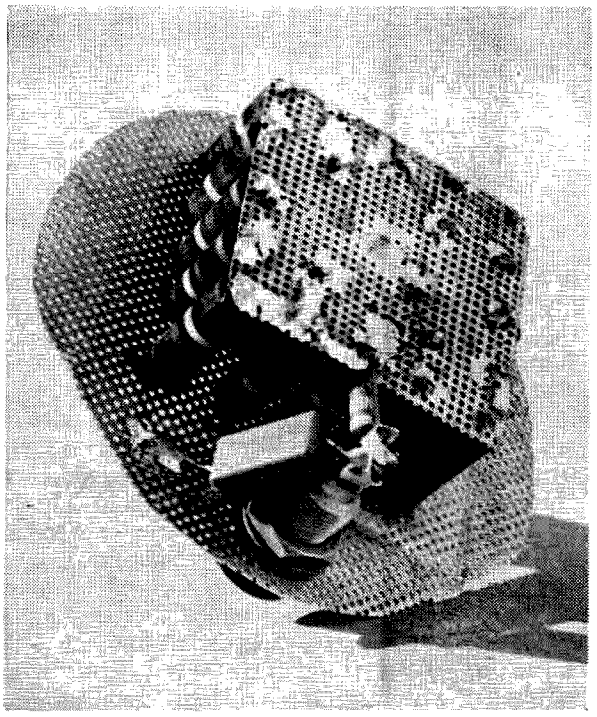
You can buy such a beastie, you know. The Bird *Termaline*, standard of the two-way communication industry, shouldn't set you back much more than a C-note . . .

But you can also build one at considerable less outlay, and that's what this article is all about.

As the photographs show, there's almost nothing to the "Tiny Terminator"—nothing, that is, but a 50-ohm load for any transmitter, which will absorb 20 watts for days on end and will handle 40 watts for brief periods (a minor modification can double these ratings), will *not* radiate rf into the ether after the fashion of the "standard" light bulb load, will allow accurate measurement of output power up past 225 mc, and can be built in less than two hours for less than $5.

You can see by the schematic that there's nothing to the device electrically; the tricks are all mechanical. Electrically, the Tiny Terminator consists of 20 (that's what we said) 1000-ohm 1-watt resistors connected in parallel, with a crystal diode running from the hot end of the composite resistor to the meter jack and a 27 mmfd capacitor bypassing the meter.

Mechanically, the big problem with a unit



such as this is the problem of keeping the load resistive regardless of frequency. Resistor leads have inductance (about 25 millimicrohenries per inch) so we get rid of the leads as completely as possible. This is done by punching holes in a flat plate, passing the lead through the hole until the resistor is flush with the plate, and soldering rapidly with a hot iron (an Ungar 47-watt 1100-degree tip was used in building the model shown) so that the resistor body won't cook before the leads and plate are joined.

The flat plate has capacitance. This is avoided by keeping the plate shielded from outside influences, and separated as far as possible from its shield.

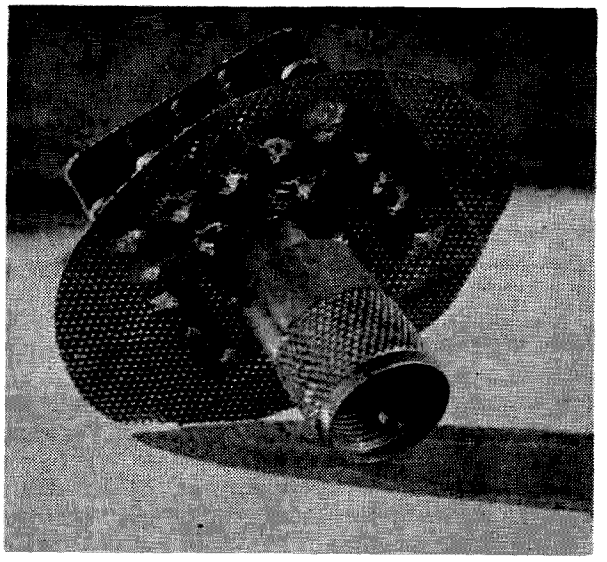
The shield, incidentally, is the bottom of 1½ inches of a Canada Dry cola, soldered all around the edge to the front resistor plate. This confines all rf inside the terminator.

Addition of the crystal diode (a 1N34 was used, but a higher-voltage unit is recommended if you ever expect to measure power higher than 8 watts) and the bypass capacitor provide the power-measuring feature. These two components, in conjunction with an external voltmeter of at least 1000 ohms per volt sensitivity, provide you a peak-reading ac voltmeter. The voltage indicated on the meter will be equal to the peak value of rf voltage present across the load. Squaring the voltage and dividing by 50 (the resistance) will give you the *peak* power. Most power ratings are in rms values rather than peak; multiplying the indicated voltage by 0.707 before squaring will give you the rms power output.

The unit shown in the photos used perforated brass stock for the resistor plates; this happened only because a length of the brass was on hand in the junkbox at the time. A cut-out tin can lid will work equally well and will be much less expensive.

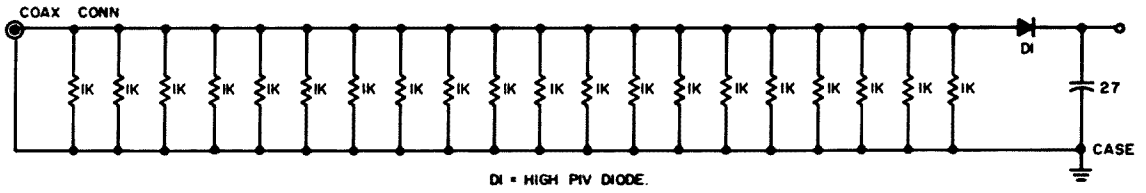
Not visible in the photos is the means of connecting the hot end of the resistor plate. A hole was punched in the middle of the hot plate and a length of No. 14 bare wire was soldered in, then filed off flush on the rear side. The bare wire was threaded through the coax connector and soldered to the center contact after checking for possible shorts.

The coax connector itself is held in place by a solder joint all around the rim of the cable-end aperture (see photo). This joint, if well made, provides plenty of strength.



Earlier, we mentioned that a minor modification would double the power rating. That modification is this: instead of 1-watt resistors, use the 2-watt variety. If you really want to go high-power, use 50 2700-ohm 2-watt resistors and have a terminator which will absorb 100 watts continuously and 200 watts ICAS. However, one that big will cost more—and you'll probably have to use a coffee can for the shield instead of the cola can used here.

. . . K5JKX/6



Old Vikings Never Die

John H. Bauer W4AWM
87 Marlborough Road
Asheville, North Carolina

WHILE making a recent tour of used equipment counters in amateur supply houses, I discovered that one piece of gear was conspicuous by its absence. This was the Viking II.

The one here at W4AWM is over seven years old, has had a life of faithful service, with few exceptions. One of these is a loss of gain in the speech amplifier. A cure for this problem has meant a modified speech amplifier for some Vikings or a distortion producing pre-amplifier for others. I tried a trick suggested by W4OXZ and it restored the gain to what it was when the transmitter was new, even with a dynamic mike. Simply replace C1 and C54, the 10 mfd 25 volt electrolytic capacitors used as cathode bypasses on V1 and V2, the 6AU6 speech amplifier tubes. You can increase the overall gain of the stage slightly by using 20 or 25 mfd electrolytics in place of the tens. Be sure to observe polarity when making the replacement.

If you find it necessary to replace an 807 in the modulator, it is advantageous to replace the other also. This is to facilitate the use of a pair of balanced tubes. You can check balance by removing one tube and noting the resting current of the other on the modulation position of the meter. Now swap tubes and again note the current. The tubes are balanced when you find a pair that draw equal current. Resting current, with both tubes in their sockets, should be within 5 percent of 75 milliamperes. Be sure the empty plate cap does not touch ground, and remove *all* voltages when changing tubes.

While the bottom is off, take a look at the pilot lamps. If they seem a bit black around the gills, it might be worth your time and a few cents to replace them now. There are several screws holding that bottom plate.

Operation on MARS or CAP frequencies can bring a note from the FCC if you have ignored reports of slightly off frequency operation. This next little item can save you the toil of crystal grinding and the embarrassment of a "pink" ticket. The first step is to obtain a surplus tuning unit type CO-985, which consists of a small fiber board with two small banana plugs having one-half inch spacing, and a couple of threaded bushings attached. A small air variable capacitor is attached to the bushings with machine screws. Remove the original capacitor and solder a 5 to 25 mmfd ceramic trimmer in its place, taking care not to overheat the solder tabs. Install the trimmer assembly in one of the crystal sockets and insert the net crystal in the succeeding one. Finally, jumper the corresponding terminals on the crystal switch SW8, thus placing the trimmer in parallel with the crystal. Turn on the oscillator and "zero beat" the net control station or an accurate crystal by turning the trimmer with an insulated tuning tool. I found that the 5 to 25 mmfd trimmer would move my 4595 kc Air Force MARS crystal several hundred cycles in each direction.

Many amateurs enjoy modifying equipment but hesitate doing so for fear that the holes left from these "improvements" will ruin the trade-in value, which is all too true in most cases. The Viking, however, lends itself quite well to modifications. Since few operators use 160 meters, the 160 meter IN-OUT switch SW6, may be partially removed to permit utilization of the front panel hole for another switch, such as an SSB-AM switch. All that is necessary in this operation is to remove the dial cord from the shaft and drive wheel assembly under the chassis, tie the cord so it will not slip through the chassis and off the switch drive wheel, and remove the shaft and wheel from the bracket. This leaves the bracket free to receive a switch, and eliminates drilling a hole in the panel.

If you plan to use an SB-10 with the Viking, drill a small hole in the chassis bottom plate and pass the coax leads to and from the SB-10 through the hole. You may now attach the coax directly to the driver and final, thus saving two connectors and a few more price reducing holes in the cabinet. A feature of this system is that it eliminates the added capacity of the connectors in the grid circuit. For electrical connections, there are four unused pins on the accessory socket, and drilling out the end of the aligning pin on the VFO plug will provide for additional leads if you are driving a modulator for a high power final in addition to the use of the sideband adapter.

Using the proper multiplier and the OFF position contacts on the meter switch, the transmitter plate voltage may be read on the meter. Utilizing the lower meter scale as 0 to 2500 volts, the plate voltage will read on the lower third of the scale which is normal for most of the current readings.

Incorporation of any of these items in your Viking is sure to bring added operating pleasure. . . . W4AWM

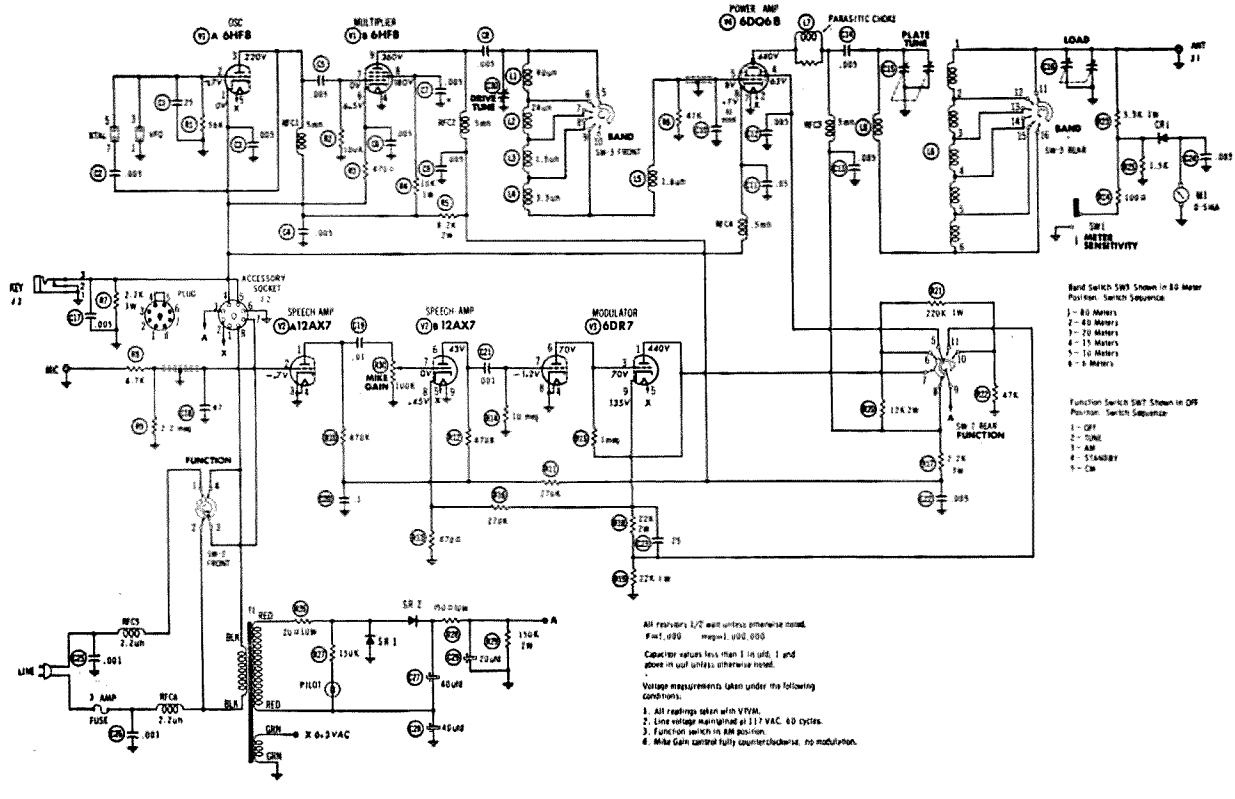
Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia



73 Tests
The Knight T-60 Xmitter

A 60 watt AM and CW transmitter with full 80 through 6 meter amateur band coverage for less than $50.00? It's hard to believe but this is what Allied Radio Corporation has accomplished in their new transmitter kit. The Knight T-60 is a completely self-contained, neat little package that puts out an amazing signal for its size.

A quick check of the specifications will verify that this easy to assemble kit is a real bargain on today's amateur equipment market. How does this Knight-Kit provide so many features at the price of $49.95? Part of the reason is, of course, that it is a kit; you supply the majority of the labor. That is, if you call the interesting, easy assembly of the transmitter labor. The design concepts that provide high performance at low cost include a silicon rectifier power supply, use of a mass produced, high efficiency TV sweep tube in the output stage and a highly effective, controlled carrier screen modulation system that provides good quality speech with plenty of punch. This audio system allows the final to loaf along at about ¼ normal power input and still approach the CW input of 60 watts on voice peaks.



These same features make compact construction possible and this little transmitter is no larger than a man-size shoe box. The gray wrinkle finished, rugged steel cabinet and the two-tone panel provide a very attractive and practical housing. Despite the compact construction, assembly is easy.

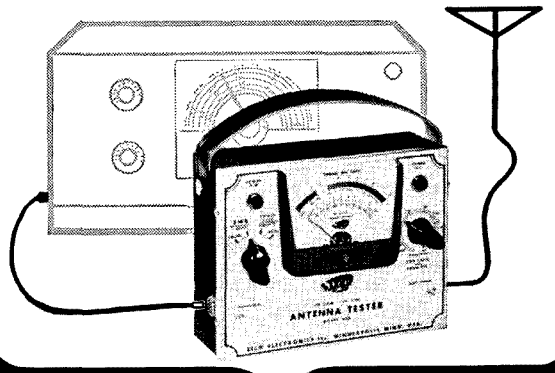
The 218 separate assembly steps are arranged in easy to understand, check-off order in the large 8½" x 11", well printed instruction manual. This 32 page booklet contains 19 clear illustrations in addition to the schematic diagram and complete illustrated parts breakdown. As a further construction aid, 6 of the major assembly illustrations are duplicated in 15" x 20" wall chart form. With all of this assistance, it is indeed difficult to goof.

Good quality parts are used throughout the transmitter and packaging of the parts is geared to convenient assembly. Resistors are card mounted and are marked for ready selection. Other small parts are supplied in transparent plastic bags for easy identification. These features, along with the illustrated parts breakdown, detailed drawings and self-checking instructions make for rapid assembly by even the most inexperienced individual.

The schematic diagram of the T-60 transmitter is shown in Figure 1. The circuit consists of a 6HF8 triode section (V1A) operating as a Pierce crystal oscillator os as a VFO amplifier. The pentode section of the 6HF8 (V1B) is used as a buffer amplifier or frequency multiplier, depending on the band in use. An adjustable pi network tuned circuit is used to couple the buffer-multiplier stage to the grid of the 6DQ6B (V4) power amplifier stage. The plate of the 6DQ6B is shunt fed and a pi network used to provide the proper match between the high impedance plate circuit and the antenna. Antennas with impedances ranging between 40 and 600 ohms can be matched with this network. Figure 2 charts the frequency coverage of the transmitter along with the recommended crystal or external VFO frequencies for each band.

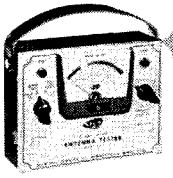
The metering circuit of the T-60 follows the trend established in several recent transmitters. A crystal diode, CR1, is used to rectify a portion of the RF present at the output of the antenna network. The filtered output of the diode is applied to the meter and a shunt resistor may be switched in to avoid off-scale deflection of the meter when feeding high impedance loads. The DRIVE TUNE, PLATE TUNE and LOAD controls are all adjusted for maximum meter deflection with the FUNCTION switch in the tune position. The switch is then thrown to the CW position and the controls peaked for maximum output. While this may appear to be a quick and dirty method of metering a 3 stage transmitter, it really works well and permits easy, accurate tuning by inexperienced operators.

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Band (Meters)	Frequency of Crystal or VFO (MC)	Transmitter Freq. Range (MC)
80	3.5 to 4.0	3.5 to 4.0
40	7.0 to 7.3	7.0 to 7.3
20	7.0 to 7.175	14.0 to 14.35
15	7.0 to 7.150	21.0 to 21.45
10	7.0 to 7.425	28.0 to 29.7
6	8.334 to 9.0	50.0 to 54.0

The cathode circuits of the oscillator, buffer-multiplier and power amplifier stages are connected to the key jack. When the key is closed, these points are at ground potential. In the key-up condition, a 2.2K ohm resistor is inserted in the circuit. The cathode current of the 6DQ6B develops a bias voltage across the resistor which is sufficient to reduce the 6DQ6 plate and screen currents to a safe value and completely cut off the oscillator and buffer stages. This design feature reduces the voltage across the open key to a safe value and provides excellent keying characteristics. There is one disadvantage to this keying circuit. If an external VFO is used, it must run continuously and keying must be accomplished in the transmitter.

In the AM mode, a cascaded 12AX7 (V2) is used as a speech amplifier which drives the first section of the 6DR7 (V3) modulator stage. This section of the modulator is operated at zero bias and grid rectification of the applied audio signal occurs. This increase in bias causes the plate voltage to rise, varying with the modulating signal. The grid of the second section is connected to the plate of the input section and this positive voltage rise increases the cathode current, and thus the voltage, of the output stage. A portion of this voltage is applied to the 6DQ6B screen. This voltage rises with modulation and varies at an audio rate, modulating the screen of the rf output amplifier and increasing the average dc potential of the screen. In the TUNE position of the FUNCTION switch, reduced screen voltage is applied to the 6DQ6B and out of resonance plate current is reduced to a safe value.

The power supply is conventional and consists of a power transformer with plate and filament windings. A full wave voltage doubler circuit, using silicon rectifiers and an RC filter develops 440 volts dc for the plate and screen circuits.

The completed transmitter was bench tested, using an M. C. Jones Type 625 wattmeter as a 50 ohm load with the internal indicator used to measure power output on 6 meters. Since the directional coupler used in this instrument is frequency sensitive, a Hewlett-Packard 41 OB VTVM was used to measure the voltage across the load and power output computed for the other bands. PA stage input power was metered and, with the transmitter tuned for maximum output in accordance with the instructions, found to range between 63 watts on 80 meters and 76 watts on 10 meters. Using *active* crystals, CW power output ranged between 40 watts on 80 meters and 26 watts on 10 meters. Efficiency on 6 meters is of course greatly reduced since the PA is operating as a doubler. Measured power output on 6 meters was 13 watts with 80 watts input. It must be emphasized that these measurements were made by tuning in accordance with the instructions, letting the operating conditions fall as they would.

A 1000 cycle tone was applied to the microphone input and a scope connected to monitor the rf envelope. The gain control was advanced to the point where distortion was apparent. This occurred at between 90 and 100% modulation, depending on tuning and loading. Measured *peak* power output was roughly equal to the CW output for identical tuning and loading conditions.

On the air tests produced good results. No attempts were made to establish any DX records, the objective being to obtain critical reports on signal quality. Comments on the controlled carrier modulation system were typical. "Your audio quality is good, OM, but your carrier seems to be going up and down." Those operators familiar with controlled carrier AM signals gave good reports. Constructive, "on the air" help in finding the proper setting of the audio gain control was difficult to obtain. The proper point, verified by the scope, is just below the setting where audio distortion becomes noticeable.

There are very few complaints with the transmitter. The comments on the metering system can not be taken too seriously since the system works and works well. The reduced output on 6 meters is more serious. However, since 6 meter coverage is a bonus anyway, we can afford to be philosophical and not look a gift horse in the mouth. The writer has personal objection to the RCA phono jack used as the mike connector and it is suspected that many will change it to a type to fit their microphones.

All in all, the Knight T-60 is a very good buy. For the Novice, it is an ideal first transmitter and it is very attractive to the more experienced amateur as an emergency or standby unit. The rugged construction and simplicity of the unit make it probable that this little rig will be in service long after more sophisticated equipment is "down for maintenance."

. . . W4WKM

(W2NSD from page 4)

quite the same again toward the club. How many defeats will they take before they drop out? Not many. You say, "Good riddance." Maybe so, but if the executive committee had pre-solved the problems then these chaps might never have become needlers.

One lousy president can undo years of club building. It does the executive committee no good if the president is not on his toes and does not see what is coming when discussion starts to heat up. He should then refer the matter to the executive committee for presentation at the next meeting and quickly get on to other business. It is up to the president to maintain order during the meeting. He should have a sergeant-at-arms to separate youngsters who sit together and are occasionally more interested in each other than the meeting. He should stop the meeting entirely when attention wanders from the matters at hand and call for courtesy to the speaker. This also acts to push a dull speaker into the closing part of his speech.

While parliamentary procedure can sometimes slow things down, it is also a useful weapon in the hands of the president to beat down disturbances. The president should know the Rules-Of-Order cold and be able to flatten anyone with them.

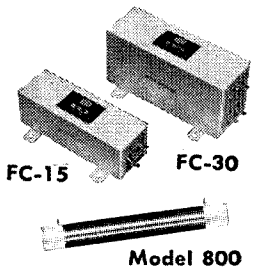
From all of the preceeding it should be obvious that I view the business part of a club meeting as the most hazardous to the longevity of the club. Unfortunately, even if the business is done away with quickly and efficiently, this does not guarantee that a club is going to survive. I do feel that it is important enough so that no matter what else the club does it cannot be a really successful club with poorly run business meetings.

What else can you do? Well, while this has nothing to do with ham radio, you should consider the possibility of serving some food during the middle of the meeting or at the end. I prefer the middle for this keeps everyone around with nothing to do but munch and talk to each other. One of the important benefits of a club is in getting people together. When you remove the chow session you cut out most of the socializing of a club. Best food? Coffee and doughnuts or cider and doughnuts. A coffee urn is a good club investment A little cup by the urn for donations should pay for the upkeep on this ritual.

After coffee, call the club back to order and introduce the speaker for the night. The president should let the speaker know what time the club usually adjourns so he can plan his talk accordingly. The president should also make sure that the speaker has plenty of time to give his talk. It is certainly not fair to ask a chap to come and talk to the club and then turn the meeting over to him at 10:30 p.m. I

(Turn to page 89)

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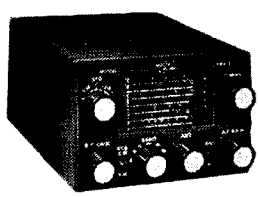
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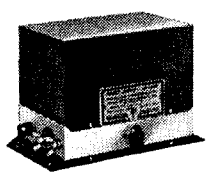
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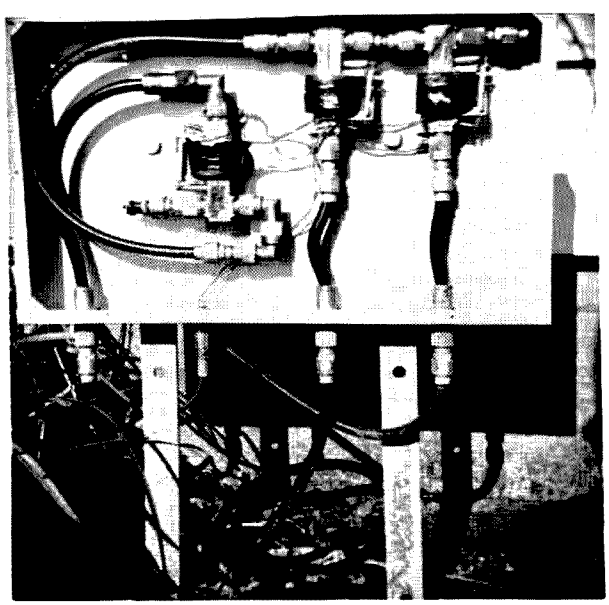
Antenna Protection and Switching Unit

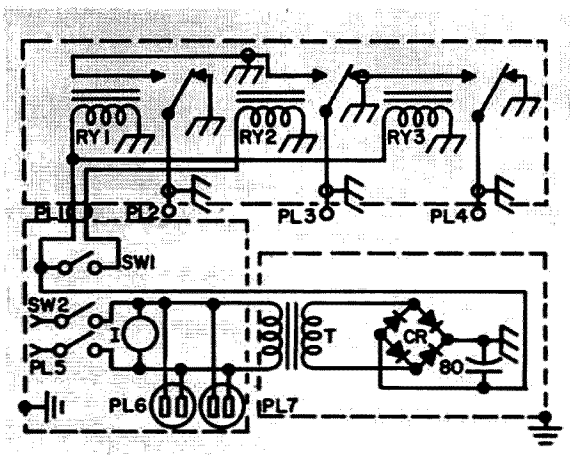
Carl Drumeller W5EHC
5824 N.W. 58th Street
Oklahoma City 12, Oklahoma

LIGHTNING protection for amateur radio antennas is nothing to be lightly regarded. Common sense dictates that no antenna installation should be without a fail-safe, neglect-proof system of ensuring that each and every antenna at the station is grounded whenever the station is closed. If such a protective system can be combined with an antenna selection system, so much the better.

This article describes just such a dual system. It provides toggle-switch selection between a trapped-doublet all-band flat-top and a tri-band rotary beam. At the same time, it provides automatic grounding of both antennas when the station receiver is turned off by a line-control switch. As a bonus item, it also ensures that one can never inadvertently leave the transmitter energized.

The heart of this system is a little box mounted outside the house. The box is grounded by its mounting legs, which are metal stakes driven into ever-moist earth. Three co-ax relays are mounted in this weather-proof box. Two of these relays are connected to the antennas and "normal" to ground. When energized, they lift the two antennas off ground and transfer them to the third relay. This third relay "normals" on the flat-top antenna, the most-used at this station, and selects the beam antenna when energized.





A heart is useless without a brain (a control center) to order its actions. The control center of this system is a 2" x 3" x 5¼" Mini-box containing two toggle switches, an over-size pilot light, and a terminal strip. One toggle switch controls the main 117-vac line serving the station; power for the relays, the station receiver, and the station transmitter all are taken from this 117-vac line. The other toggle switch merely controls the antenna-selector relay. The king-size pilot light, with a 117-volt, six-watt bulb, being across the station master power buss, provides an attention-demanding indication of a "live" position of the main-line toggle switch.

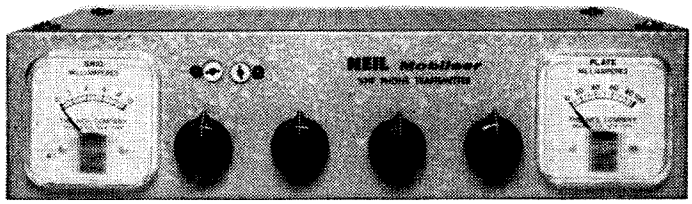
"Muscles" for the heart may come directly from the 117-vac line or, as in this case, from a 24-vdc power supply. The selection of 24-vdc for operation of relays was based solely upon the highly-important item of having three 24-volt relays available.

Construction is simple. The relays are mounted in a 10" x 2" x 17" chassis pan. A standard chassis bottom-plate provides an adequate cover, held on by self-tapping screws. As shown in the photograph, the relays are mounted in a rather unorthodox fashion dictated by the availability of connectors. It will be noted that two relays are joined by a male-to-male co-ax connector; therefore they are mounted closely together. The third relay sits off to itself; two right-angle connectors make possible its attachment to the center relay without a short-radius bend in the co-axial cable.

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Along the bottom edge of the box are mounted three co-ax feed-through connectors and a two-prong chassis connector for the control lines.

Shorts for grounding the "normal" positions of two relays are made from male connectors with a very short piece of co-ax cable attached; the inner and outer conductors of the cable are soldered together.

As indicated in the schematic diagram, wiring is simple and needs no special explanations or precautions.

Operation of this system has proved satisfactory in all respects. About the only refinement that could be desired would be an interlock circuit that would inhibit the selection of the 10-15-20 meter beam when the transmitter was tuned to 40 or 80 . . . but that would be asking for egg in one's beer! . . . W5EHC

$R1_1$, $R1_2$, and $R1_3$: 28-vdc SPDT coax relay
$P1_1$: Female 2-prong chassis receptacle for control circuits, with plug
$P1_2$: Female coax chassis receptacle for beam antenna
$P1_3$: Female coax chassis receptacle for coax to Send-Receive relay
$P1_4$: Female coax chassis receptacle for trapped doublet antenna
$P1_5$: Male chassis plug for 117-vac input
$P1_6$: Female chassis receptacle for 117-vac to receiver
$P1_7$: Female chassis receptacle for 117-vac to transmitter
CR: Full-wave bridge rectifier for 28 v, 2 A
T: Transformer, 117 v to 28 v
I: Dial light, 117 v, 6 w
Sw_1: SPST switch for antenna selection
Sw_2: DPST switch for ungrounding antennas and powering receiver and transmitter

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"HONEY," asked the dreamboat DL on leave in London, "did he use the potentiometer system of bias stabilization?"

"Honey," I replied, wondering why Englishmen could never make a question like that sound sexy, "maybe he did, maybe he didn't—I wouldn't know. But I do know how to make perfect coffee!" And in a British house that's saying something.

This is no ordinary amateur radio establishment. Our motto is "If you can't work the DX, then invite them!" And with the h.f. bands in the condition they have been for the past year or so, our DX score is mounting fast. When Loverboy works a remote station he isn't satisfied just to talk to them. "Any time you're in London," he burbles, "drop in."

And they do. From France and British Guiana, from America and Australia, from Switzerland and Kenya, they come with their wives, children, girl-friends. Only our blessed quarantine laws prevent their bringing their dogs too. Operation DX Guest has now become routine in our house. My younger son is so tired of giving up his room to visitors that he can't wait to take his own license and spring a nice surprise on some unsuspecting XYL in Paraguay. True the household has become geared to these little incidents. One night we were out at a theatre and I phoned home to make sure that the babysitter had put the kids to bed—and not vice versa—and she said a Chinese gentleman had called. She had given him a meal and should she put him to bed too. Another freezing, pouring night—in July—an SM5 knocked at our door at 11:30 to say he had been told by his local radio club that this was a hotel. Period.

The first thing I do in these cases is to find out whether the client has any food preferences. Embarrassing situations arise, like the day I served roast beef to find that the visitor was a practicing Hindu. I once asked a VP8 whether he ate everything and he replied that he was allergic to eggs. He could only eat penguin eggs. A maratime mobile K2 used to call my husband from mid-Channel to tell him to put the beer on ice. He knew his Britain. A wandering K6, who claimed to be on vacation in London doing an overseas Kinsey report, taught me to cook paella. He had perfected this recipe whilst on top of an 11,000 ft. mountain, with a YA1 call. My electric range was hotter than the dried dung fire on which he had experimented—or perhaps the essential part of the recipe was the chunks of dried yak—but it appears the resultant goo wasn't quite up to Afghan standards.

A knowledge of languages is a great help with these customers. We can cope with French, German, Italian, Polish, Russian and American. We speak no Spanish. Came a YV1, all eager to "make a nice QSO with Caracas." How to explain to him, with his four words of English, that British regulations forbid any other than a licensed G to speak over the rig? He made a polite show of understanding, but I know he left convinced that George Washington knew what he was doing in 1776.

We throw a party at the drop of a hat. One night a man phoned to say we were breaking through on his TV. I went cautiously into the TVI-coping spiel with expressions of guarded regret, then thought to enquire where he was located. Bronx. Within an hour we had rounded up the local radio population and had us a party which lasted until 2 a.m. and confirmed the neighbours' opinion that we are all nuts.

Naturally visiting amateurs evince great interest in the rig. I don't know a dishwasher from an 813, but I look after the clerical side of the station. For this purpose I have evolved an index system which I can say, with true British understatement, is the finest I know. I was trained to keep records in the best school in the world—the British Foreign Office, where we had to produce documents thirty years old on seconds of demand. Certainly our index doesn't carry such weighty information as what Clemenceau said in 1917 to Wilson, but we love it just the same. Certain items appear which could not be said to be strictly technical. One K4 is known as "Old Rumleguts." A DXCC (twice over) with whom we had personal, perhaps too personal, contact is described as "Wandering Hands." An XYL in California is listed as "Swell Dish" —well surely Loverboy is entitled to get *some* pleasure out of amateur radio!

The visiting amateur, bemused with all this efficiency, often turns to his wife and says "Why can't you do something like this, Doll-Baby?" Doll-Baby is non-commital — merely turns her strontium-loaded glare on my inno-

The coffee business demonstrates just how amateur radio can change your life. I now know three different ways to make coffee—French, American and Turkish. That, in itself, shows the miserable depths to which we have plunged, for there is something frightfully un-

British, almost caddish, about coffee. But a Canadian guest, with that charming frankness which permits the VE's to insult you and yet leave you smiling, suggested that my coffee, which I had offered him only as an international compliment anyway, might possibly be the cause of another Boston Teaparty. He had a can of coffee sent from Montreal, told me where to buy it in London, stood over me whilst I concocted the brew to his liking and now appears regularly to do spot checks.

There was the WI whom we were taking to London Airport with his wife after they had spent some days with us. I stopped the car and bought a bunch of roses for Alice, thinking how wonderful it was that these same flowers would decorate their table that night back in Boston, Mass. Next week he told us that they had the devil of a job getting the roses through the Boston Customs because the Officer had found a louse on one of the blooms. That was one louse less in London.

One weekend we had two VK's staying with us. My elder son had been miserable for the previous week and blossomed forth that morning covered with little red spots. I phoned the doctor, who came straight round. I opened the door, said "Sh-h-h," and sent him up to the patient. Ten minutes later he came down, announcing triumphantly that it was measles. He was sh-h-h-d once more by an unimpressed mother, a pair of large and ecstatic Australians and a most disinterested father who had just got a 5-9 report from a VR1 and was utterly detached from trivia such as anti-biotic and linctuses. The doctor left the house suitably abashed, having learnt things that never appeared in any Materia Medica.

All our visitors teach us how to live. We patiently bear the criticisms of our small cars, expensive gasoline, our plumbing, damp climate, terrible coffee, ubiquitous tea, socialized medicine, privileged aristocracy, narrow roads and 150 watt maximum power allowance. Then we carry on blithely, until the next batch of DX arrives.

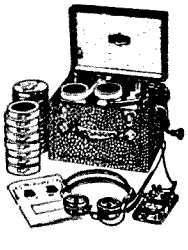
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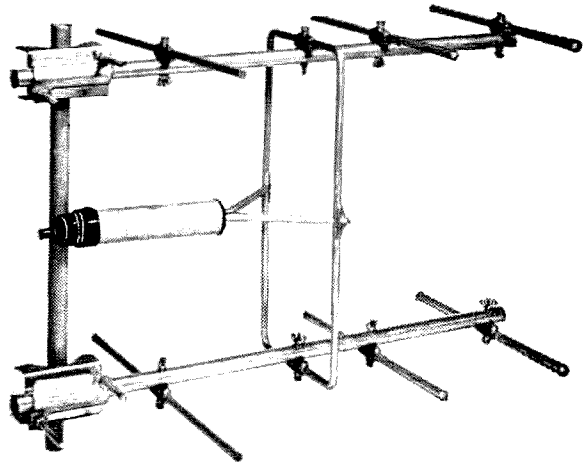


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solder run down inside the 7-pin miniature tube socket!

When all is completed, connect the feedline from the antenna to the booster input terminals, and connect a suitable length of similar line from the output of the booster to the receiver antenna terminals. Then, with SW2 (bypass switch) in the bypass position, turn on receiver and tune in a signal in the normal manner. Our incoming signal at his time is bypassing the booster and going directly into the receiver. Now turn SW2 to the operate position and tune the booster for maximum signal strength. The cathode pot (10,000 ohms linear taper) is our rf gain control. That's all there is to it! Once the booster is tuned for maximum for say the middle of the band, it seldom will need be returned over that one band as such a booster's grid tank is rather broad tuning.

Parts List

Quantity	Item	Approx. Cost
1	10 ohm ½W resistor	.12
1	330 ohm ½W resistor	.12
1	4.7K ohm ½W resistor	.12
1	10K linier taper pot	.91
1	33 ohm 2W resistor	.24
1	1K 2W resistor	.24
3	.01 mfd 600V disc cap	.54
1	200 mfd 600V S.M. cap	.12
1	150 mfd APC variable cap	1.19
1	dual-section 30-50 mfd 150V filter cap	.49
1	.015 mfd tubular cap. 400V	.10
1	Selenium Rectifier SR-65	.47
1	2½Mh—50 ma Radio Freq. Choke	.30
2	Z-50 rf choke	.90
1	4-pin tube socket	.13
1	7-pin miniature tube socket	.23
1	S.P.S.T. toggle switch	.39
2	Two-Terminal strips—screw type	.12
1	D.P.D.T. toggle switch	.78
1	Power XFMR—Pri-117v ac. Sec-125v ac & 6.3v ac @ 3 amp	1.45
1	AC line cord with plug 6AK5 radio tube	.99
2	Knobs	.22
1	Aluminum 5" x 4" x 5" L.B.M. Box	1.41
	Total approx. cost	$11.48

Coil Data

A set of ready-wound I.C.A. coils cost $2.49 and cover from 160M through 10M. If you prefer to wind your own, four prong 1½" diameter ribbed coil forms cost about 51¢ each. Leave about ¼" between the primary and secondary windings.

Frequency Range	Grid Turns	Primary Turns	Winding Length
1800-2300 kc	82T—#28	16T—#30	1⅞"
2000-4500 kc	38T—#26	11T—#30	1⅝"
4000-9000 kc	18T—#24	6T—#30	1½"
7.3 -17 mc	9T—#16	5T—#30	1½"
15 -33 mc	3½T—#14	3T—#30	1"

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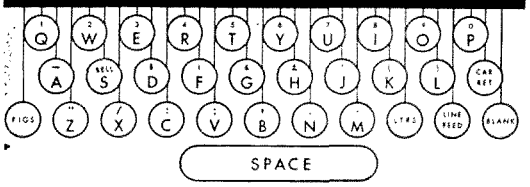
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Here is a list of all surplus conversion articles ever printed in 73, QST, CQ, Radio News, Electronics World, Radio-Electronics, etc. If you are interested in surplus then this book will be invaluable. Each listing gives a thumbnail description of the conversion.

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Evolution of the Bug

Louise Moreau W3WRE
639 Russell Avenue
Johnstown, Pennsylvania

CONTRARY to present belief, the semi-automatic key is not a Twentieth Century invention, nor was it primarily intended as a speed key. The instrument was one of the many that were designed to either ease or prevent "telegraphers paralysis," or "glass arm," the occupational disease of the profession. This became a very real and serious threat to the operators almost as soon as the Telegraph industry was formed. As the work of the telegrapher increased into the tremendous output of anywhere from ten to eighteen thousand words in a single trick, it became apparent that something had to be done to ease the strain on the muscles of the wrist and arm. Quite often continuous operation with the hand keys could and did produce permanent disability.

All sorts of gadgets were tried and used by those who were afflicted, the so-called "side-swiper" being among the most popular forms since the horizontal action of this key produced less strain, and the effects were lessened.

By the 1880's, the first semi-automatic-type keys, or those that produced a series of self-made dots, appeared under the general name "Vibrating Keys." These were bulky, cumbersome instruments equipped with magnets to hold the vibrating portion, and each one required a pair of dry cell batteries to activate the magnets. Actually these batteries and magnets served still another purpose, they not only created the multiple dot action of the key, but were also used to overcome the line-lag that was present during the days of iron wire on the telegraph lines. They were inefficient, since there was either a very primitive damping action, or none at all.

Most of the operators, who took great pride in their daily output of many thousands of words, would have nothing to do with these instruments, and ranked them with the anathema of the wire fraternity, the "Plug," or poor operator, whom they referred to in the slang of the day as a "Bug." These keys were called "Bug's Keys" or fit only for a "Bug" to use; and "Bug" in the 80's meant much the same as the term "Lid" does now in the wire game, hinting at dubious ancestry.

The original meaning died out, as slang terms do, so that, by the turn of the century, "Bug" had become generic, designating any key that sent a string of dots, while the dashes were made manually.

In 1903, Horace Martin patented his first form of this key. Martin was concerned not only with producing an instrument that would make operating easier, but would also increase the sending speed. He was encouraged in this by the publisher, Walter Phillips, who was always looking for faster sending methods, and as many short-cuts as possible to increase output. Phillips held one half of the first Martin Patent Number 732,648.

While the 1903 Martin Patent is mainly an improvement of the earlier Vibrating keys, and still employed the battery-magnet action, it is interesting in that Martin saw the possibilities of utilizing many different forms of the vibrating action, and, included in his description every possible method. When the United Electric Company manufactured and sold the first of the "Martin Telegraphic Transmitters" they were making the only "legal bug." Legal, because Patent No. 732,468 completely closed

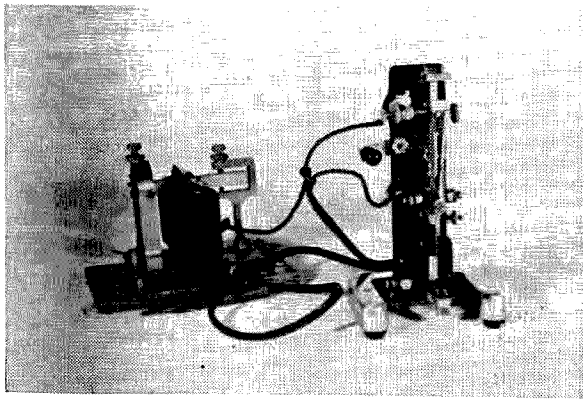
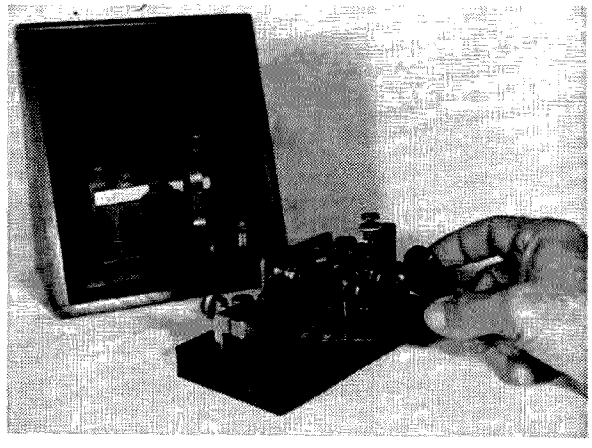
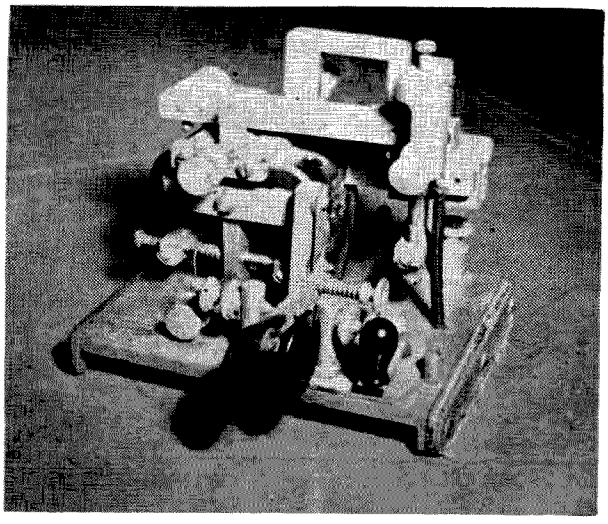


Photo from the L. R. Moreau Collection
Upright model Vibroplex, 1918. Known also as the "Wire Chief's Key," it was designed by H. G. Martin for use in crowded operating space.



Early Mecograph Key—1906. Popularly called "The Right Angle Bug" by telegraphers. This is the first of three models made by the Mecograph Company.



Martin Telegraphic Transmitter. This is the first of the Martin semi-automatic keys, produced in 1903, using a magnet and battery action. This is the ancestor of todays semi-automatic keys.

the field to anyone else. No matter what design the key took, or how it operated, it ran headlong into the Martin Key. William Albright, another telegrapher, joined Martin and the Vibroplex Keys, as we now know them, began to appear with a name plate reading:

The Vibroplex
Horace G. Martin's
Patent No. 732,648
Patent No. 767,303
Others Pending

The batteries and magnets had been eliminated, and the famous Martin damping action had been added, and, in 1907, it was Martin who coined the phrase "Semi-Automatic" as a description of the action of the key.

When anything new, with plenty of sales appeal appears on the market, there is a rush to cash in on the golden shower of profits. Many independent companies appeared with what they hoped would be ways to get around Vibroplex. The Mecograph Company, of Cleveland, Ohio, produced three different kinds of "Right-Angle Bug," or the "Mecograph Key" that had the vibrating reed at right angles to the lever, and used a "release" rather than a pressure on the spring to make the dots. There were also key-wound, spring-driven instruments, and those with a pendulum action. There were even those with a dual-key arrangement, much like a Cable key whereby they were operated with a drumming, vertical movement of the fingers. But they all fell before the legal might of the Vibroplex Company and were forced to close.

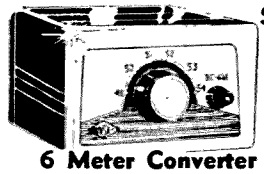
At first the telegraph companies would not permit these keys to be used at all. Many operators objected to receiving on a wire where the sender was using a "bug" and refused to copy. But Albright was busy selling the



Leo I. Meyerson
WØGFQ

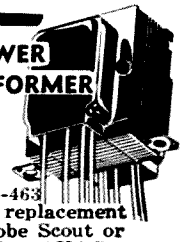
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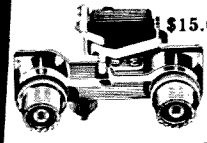
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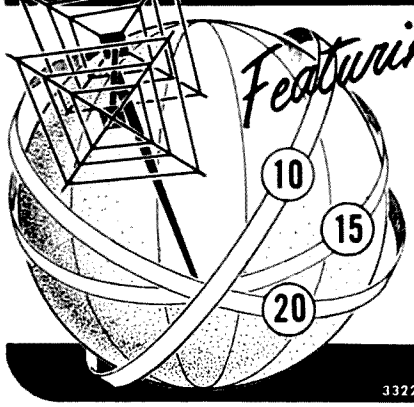
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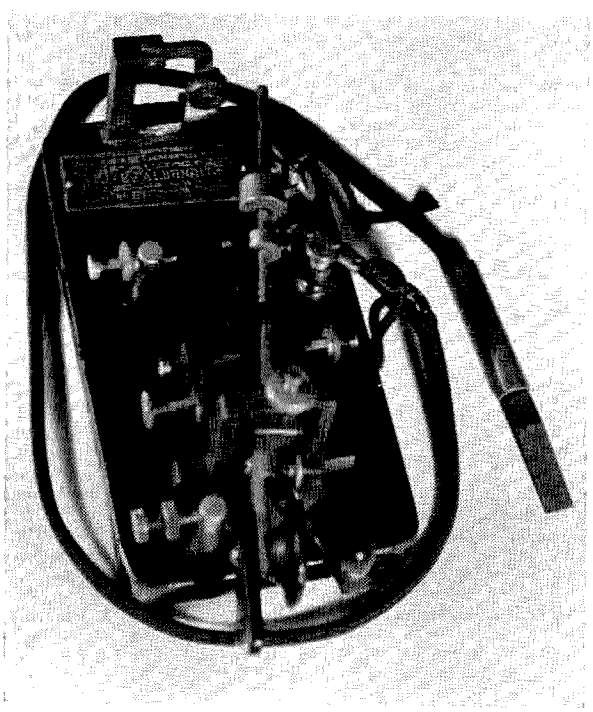
CUBEX COMPANY

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companies on the efficiency and speed of the instrument. Now that the typewriter was being used more and more in the telegraph offices, the increased facility in receiving made it almost imperative to have a faster transmitting instrument.

Western Union, and Postal Telegraph finally agreed in the use of this key by the operators, but only if the instrument were set for a maximum of eleven dots per second. Some of the office managers insisted that the weight be soldered at this setting. This, of course, achieved a universal rate over all the wires.

With the acceptance of this instrument by the telegraph companies, the demand for it became even greater, and many independent manufacturers made a comfortable profit from the operators who wanted their own personal keys. However, these "Bootleg Bugs," or "Illegitimate Bugs" were not accepted for use by either Western Union or the Postal Telegraph, who had an agreement with the Albright Company to use the Vibroplex, only. The operators protested, when they found that their favorite sending instrument could not be used just because it had been declared illegal by the Courts, when the keys they were using had proved to be efficient. So, a compromise was reached in the form of the so-called "Albright License," a metal plate attached to the base of their keys that read:



"Albright License." This brass plate, attached to base of keys not accepted by the telegraph companies, authorized the use of the key by the operators.

This machine not guaranteed nor made
but only licensed by
J. E. ALBRIGHT
233 Broadway, New York
Special No. ————

These plates were sold to the operators for two dollars, and once they were attached, the key was legally usable.

The semi-automatic key remained exclusively with the telegraph industry until CW appeared in the wireless field. The earlier wireless could not follow the fast dots, nor was the key itself designed to break the heavy primary current of "spark" transformers. A Bug, however, was used in 1909 on Wireless as an experiment by E. N. Pickerill, from the De Forest Wireless Station at Colorado Springs, by operating it through a Relay Key. This is the first recorded use of one of these keys for wireless telegraphy.

The name "Bug" is a copyright of the Vibroplex Company as is the little insect depicting a "lightening bug" on the name plate of the modern keys. The insect is contemporary, as is the copyright. However, the idea is as old as the keys themselves, for, in the early issues of the "Operator," the newspaper of the profession in the 1870's and 1880's, cartoons of the "Plugs" (those "lids" of the wire who broke with intent to interfere; used a busy wire to practice, or as one wit of the day described it "6ASTISE"; and generally made life miserable for the busy operators), quite often had a carefully sketched insect, much like a mosquito, inserted in the drawing. It does not appear in any other type of cartoon.

. . . W3WRE

Jim E. Thompson, Jr. W4THU
8129 Elsie Circle
Norfolk 3, Virginia

Cure that Angry Band

Audio Selectivity: Your key to improved CW reception

Do you own one of the less expensive short wave receivers that makes an excellent showing in all respects—except selectivity? Do you always have trouble copying the other fellow because of QRM, and in many instances lose his signal altogether? This annoyance takes away from the enjoyment and pleasure of amateur radio. If this is your problem, the government has already solved your problem for you—both simply and cheaply. The cure for your selectivity problems is a filter which wears the tag: FL-8 Audio Filter.

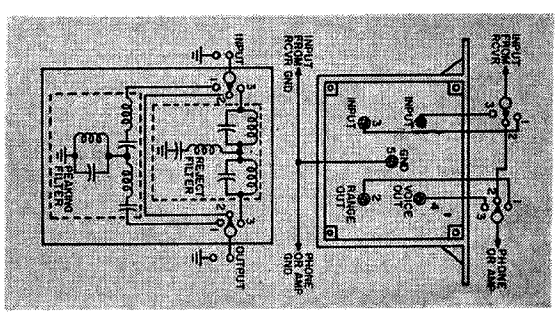
Audio filters, like all other types of external filters, have their disadvantages, but contribute many outstanding features. A list would include: no external power requirements, good selectivity, low cost and absolutely no internal connection to the receiver.

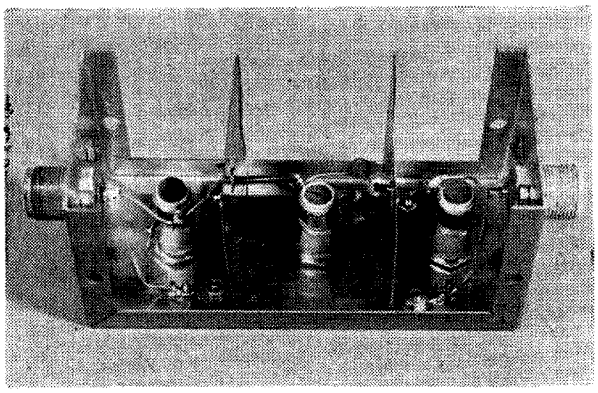
The filter unit is available from most large surplus stores. By the way, when ordering from any of the larger surplus stores, specify both the FL-8 and the FL-5F Audio Filters, and let them send the one which they have on hand at the time. Try to secure a FL-8 filter because it has built in "peak-null" switching. The price should be under five dollars for the FL-8 and under four dollars for the FL-5F.

Circuit wise, the filter consists of six L-C tuned circuits, tuned to a frequency of 1020 cycles. Three of the tuned circuits are devoted to the peaking function and the remaining three are used in the nulling circuits. The different functions are switch selected by a three position switch, marked: Range (peak), Null, and Both (filter off).

In operation the filter passes only those signals that beat with the BFO to produce a beat tone of 1020 cycles. As a result the filter "washes" out most of the QRM and QRN that are not audible at 1020 cycles. Thus the spectrum is relatively clear of all signals except for the 1020 cycle beat tone.

It might be well to say, here, that the filter cannot be used on "fone" as a peaking filter because it is far too selective to pass voice intelligence, but can be useful in eliminating heterodynes.


INPUT
OUTPUT
PEAKING FILTER
REJECT FILTER
.005
.005
.005



BCI in your QSO?

Allie C. Peed, Jr. K2DHA
34 Ashley Drive
Rochester 20, N. Y.

DID you ever notice that most of the books and articles which treat with broadcast interference deal with the subject from the standpoint of interference by amateur transmitters to receivers operating in the broadcast band? But, the reverse situation can be a problem to urban hams who live fairly close to broadcast stations.

Take it from one who knows, this can be a problem of some magnitude too. I live within sight of the antennas of five local broadcast stations—not to mention two TV stations and a couple of FM stations. All of these are within a two mile radius of my QTH. From the initiation of operations from this location there were multiple appearances of broadcast signals of poor quality but good strength in the lower ham bands. The 160-meter band was blanketed and for all practical purposes totally unusable, 80-meters had about fifteen distinct places where strong BC "garbage" could be heard, and the 40-meter band had about six S-9 spots. However, I accepted these as my cross to bear and went about fitting my operating into those frequencies which were clear of the interference.

Then, recently, I installed a new antenna twice as long as my previous one and the ripe banana hit the fan! The BC interference became so strong that operating on 80-meters was impossible at any point, and better than half of the 40-meter fone band was occupied by a mushy omelette of several broadly tunable BC signals. Obviously something had to be done.

There is no need to recount at great length all of the empirical things that were tried in attempts to locate the source of the trouble. None of these did much more than give clues to areas of possible difficulty. In fact, the solution to the problem was greatly complicated by the fact that no single thing completely and clearly was the total source of the trouble!

First, it was noted that BCI was experienced in every audio amplifier in the shack (an intercom, a tape recorder, and a phono amp) when the lead-in from the new antenna was brought in through the wall and connected to the receiver (a Hallicrafters SX-101). This was first thought to be due to the fact that the RG-8U coax came through the wall and passed right by the Romax bringing the 110-volt ac power into the shack. Since Romax is unshielded, having as it does only the two power leads and a ground wire surrounded by insulation, it was decided to lessen the coupling between the power distribution system and the antenna. This was done by replacing all of the Romax with BX cable which is enclosed in a grounded metal sheath. This made some improvement in the strength of the BCI in the audio amplifiers, but had little effect on the strength of the interference in the ham bands.

Next, the grounding of the station equipment was investigated. It was the usual hurriedly installed temporary type which we had never gotten around to re-doing properly. It consisted of a ground clamp on a convenient cold water pipe. Then, as additional pieces of gear were added on the operating desk, they had been merely allowed to ground through their interconnecting leads or pieces of hook-up wire had been run from one chassis to another—a real mess.

(Continued from preceeding page)

switch to "Peak" and listen to the same signal. You should hear nothing but this one signal. Now tune up and down the band. There is quite a difference, isn't there.

The best method for tuning the desired signal is to tune the receiver in the "Both" position. When the desired signal is found, switch to "Null." Now very carefully tune the receiver until the signal is nulled out. Turn the filter to peak and you will have the signal tuned perfectly.

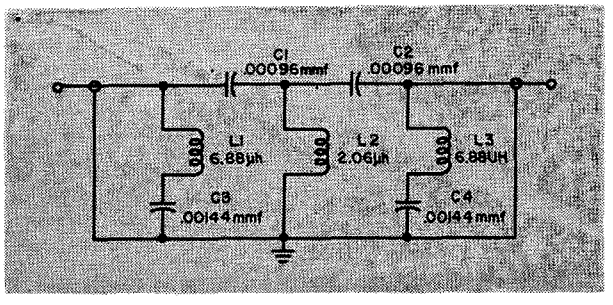
Well, there you have it. Five dollars and half an hour's work will surely be rewarded with improved reception. . . . W4THU

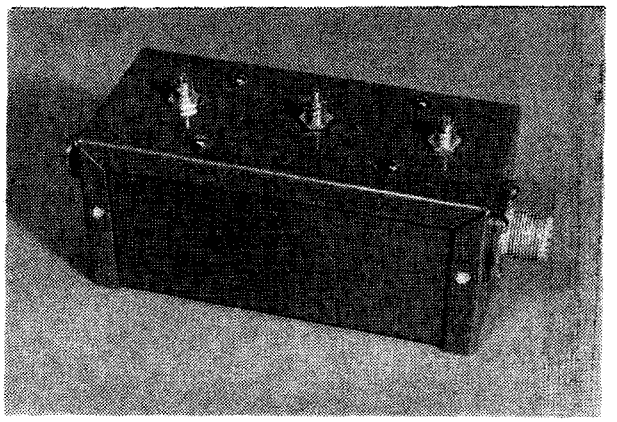
All of the old grounding was removed. Three of the copper plated steel ground rods sold for rf grounding purposes were obtained. These were driven down into the ground at three locations alongside the house about ten feet apart. They were all bonded together with #6 aluminum grounding wire and a flexible lead of #12 stranded copper was brought from this into the shack through the wall. This was run from grounding point to grounding point among the gear on the operating desk. Each point of connection was fitted with a copper plated lug of proper size crimped onto the wire and soldered thoroughly. This made some improvement in the BCI situation and also served to clear up some of the chassis which had previously had a tendency to "tickle" just a bit when they were touched with sweaty hands.

But, I still had BCI in the station receiver. It was improved noticeably over when I started, but was by no means reduced to a level which I could live with.

Next, I carefully measured and logged the frequency of each place where I had a recognizable BC signal. Then some trial additions of mathematical combinations of the local BC frequencies was tried and it was found that at every possible combination of sums of the local frequencies I could identify a mixture product. It became something of a game to add up combinations of local BC frequencies (including second harmonics) to predict the location of a phantom mixture product. I would then tune the receiver to this calculated frequency and invariably find my predicted phantom signal. Of course, this meant that I was getting mixing of the strong local signals in some non-linear element. The mixture products were being either re-radiated to the receiving system or being generated in the system itself.

The possibility of rectification and re-radiation external to the system was first investigated. I borrowed a portable battery operated communications receiver and tuned it to one of the stronger BC signals in the 80-meter band. In the shack it was as easy to find on this receiver as on the station receiver. But, when I went outside and started walking around, the signal became weaker. It could be found easily when the portable receiver was brought under the station antenna, or near the powerlines. This pointed the finger in the direction of the mixing taking place in the





station antenna or equipment. So, the investigation was pursued along these lines.

First, the antenna itself was inspected. Every solder joint was sweated. Every screw connection was "strapped" with braid and soldered. This was done just to be sure that no non-linear joints were present in the antenna system to allow mixing to take place. One particularly bad joint was found and cleaned up and this made a gratifying improvement in the BCI situation. While I was up on the roof the connections on the TV antenna were cleaned, tightened and given a coating of protective spray just to be sure that they weren't contributing to the trouble.

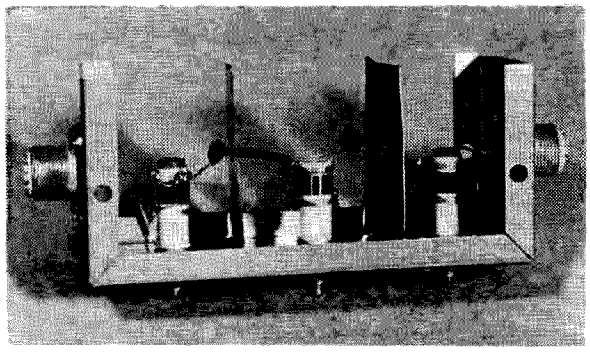
Next, the TR switch was suspected since these have a bad reputation when they are subjected to strong local signals. So, this was removed and replaced with a coax relay. Again some improvement was noted, but it was still possible to find a few of the stronger BC signals on both 80- and 40-meters.

The next assumption was that the mixing must be taking place in the rf amplifier and mixer stages of the station receiver as a result of their being overdriven by the strong BC signals. The best way to check this seemed to be to keep the BC signals out of the receiver front-end. So, for this purpose, a high-pass filter was indicated.

So, back to the textbooks. No need to go through the tedium of the calculations. End-sections, M-derived, T-configuration were chosen with a constant-K, T-configuration center-section. It was decided to have the filter cut-off at 2-megacycles which was well above the highest broadcast frequency. (If 160-meters had been a consideration, the cut-off frequency would have to have been moved down below 1.8-megacycles.)

Knowing that the filter was to work into a nominal 52-ohm coax line, and using the usual value of m = 0.6, a filter was designed by plugging these values into the bandbook formulas and turning the mathematical crank. These reduced to the values shown in the schematic accompanying this article.

Since the inductances required are rather small, it would be possible to wind them yourself or cut appropriate lengths from commer-



cially available coils such as the B&W Miniductors or the equivalent. However, in the interest of having some variation in inductance available for experimentation purposes, commercially available variable (slug-tuned) inductors were chosen (Miller 4400 series). The calculated capacity values were rounded slightly to those available in the standard disc ceramic type capacitors.

A Bud CU-2104-A aluminum Minibox (5 x 2¼ x 2¼") was chosen to house the filter, but any other convenient size would do as well. Two chassis-mounting coax fittings were obtained from the junk box, and the metal shields between sections of the filter were cut from a tin can.

Construction took about an hour and consisted of drilling holes to mount the coax connectors in the ends of the box, cutting the interstage shields to fit inside the box and bending a foot on them which was drilled for mounting inside the box. Then three holes for the three coils, and holes in each of the two shields for the series capacitor leads and the job was done except for mounting the components and soldering the connections.

The slugs in the coils were set at about the position in their travel which should give the desired inductance within the specified range of the particular coil. For example, where 6.9-microhenries was called for in the end-section coils, and the coil chosen had a range of 6.7- to 15-microhenries, the slug was adjusted almost to the end of its travel out of the coil for nearly minimum inductance. The center coil had its slug adjusted about a third of the way in by a similar reasoning process.

The filter was checked quickly after it was completed by using a signal generator and rf voltmeter. (It was terminated with 56-ohm carbon resistors for the check.) This revealed a rather nice roll-off in the vicinity of 2-megacycles and this dropped below the sensitivity of the meter by 1.6 mc. Some adjustment of the coil slugs was tried, but without much notable improvement in the filter performance. So, it was assumed that the original settings were good enough.

Of course, "proof of the pudding is in the eating." The antenna was unscrewed from the back of the receiver and the filter was connected into the coax line using a male-to-male coax fitting on the receiver side. The receiver had been tuned to the strongest of the BC signals before the antenna was removed. This signal measured 10-db over S-9. As soon as the filter was installed, this same signal had dropped to an S-3 on the meter—hardly noticeable above the noise level. The insertion loss on the amateur signals wasn't significant. Further checking of the 80- and 40-meter bands revealed that the last vestiges of the BC signals were hardly noticeable at any point. I now had the full band back in operation for ham purposes.

The conclusion was that there were several contributing factors to the BCI in the ham bands. Strong local BC signals were given an opportunity to mix due to conditions in the equipment lashup. By proper attention to all of these, the problem was effectively eliminated. It was a long hard process, but the results were worth it.

If the investigation with the portable receiver had revealed that the spurious BC signals were coming from some external rectification and re-radiation phenomenon in the locality, the problem would have been even more complex and its solution would probably have necessitated calling in the local utility company interference expert. Poor joints in the wires of the power system can act as rectifiers, and the attached power lines act as both antenna for reception and for re-radiation of the mixture products. The power company is as interested in elimination of these lossy joints as you are, and if you can demonstrate that you have reason to believe that you have one in your vicinity, they will usually offer considerable expert help in its location and elimination.

But, utility lines are not the only offenders. Troubles of this sort have been found in corroded joints in metal guttering and down spouts on buildings, corroded connection in TV antennas, in heating ductwork inside houses, and even in fuseboxes with dirty or corroded connections. To locate these is often difficult and time-consuming. Pity the poor OM who has such a rectifying joint right in his own antenna tower!

The references which proved most helpful in work on this problem were:

1—**How to Locate and Eliminate Radio and TV Interference,** Robert D. Rowe, Second Edition, John F. Rider, Publisher.

2—**Television Interference, Its Causes and Cures,** Phil Rand, W1DBM, First Edition, Nelson Publishing Company.

3—**The Radio Amateur's Handbook,** Chapter on Eliminating Broadcast Interference, ARRL.

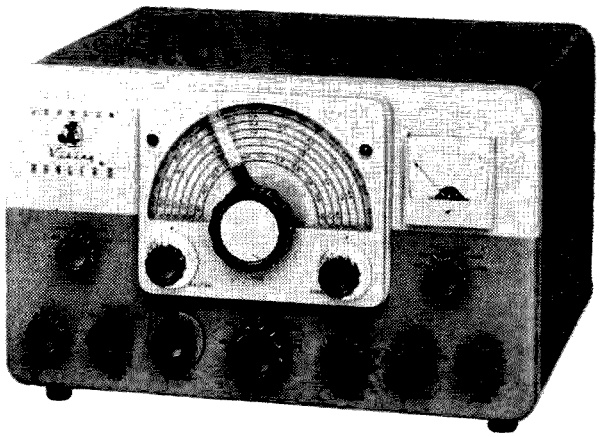
4—**The Radio Handbook,** Fifteenth Edition, Chapter on Television and Broadcast Interference, Editors and Engineers, Ltd.

Parts List

1—Minibox, 5 x 2¼ x 2¼", Bud CU-2104-A or similar.
2 ea. disc ceramic capacitor, 0.001 microfarad (C_1, C_2).
2 ea. disc ceramic capacitor, 0.0015 microfarad (C_3, C_4).
2 ea. Miller 4406 adjustable rf coils (6.7 to 15 microhy.) (L_1, L_3).
1 ea. Miller 4404 adjustable rf coil (1.5 to 3.2 microhy.) (L_2).
2 ea. SO-239 chassis mounting coax connectors.

Charles E. Spitz W4API
Associate Editor

73 Tests The Viking Ranger II



THE Viking Ranger probably needs less introduction to the amateur fraternity than most any other piece of gear. It was the creator of the trend towards making a small and complete transmitter package by the incorporation of an integral VFO. No outboard gadgets other than your mike, key, (crystal if you desire), or antenna relay is required to put you on the air on any band from 160 to 6 meters. The Ranger II incorporates all of the modifications and improvements brought out for the basic Ranger to date, wrapped up within a new two tone grey ventilated steel cabinet.

The Ranger II is designed to meet the needs of the greatest possible number of amateurs; General, Technician or Novice, CW or AM phone, the 6 meter enthusiast or the 160 meter specialist—and all of the bands in between, all as a fixed station or portable. In addition, the rf section may be used as an rf exciter to drive anything in the kilowatt class, and the audio section will drive any high power modulator. Physically it is small, being 15½ inches wide by 9⅝ inches high, and 14 inches deep, weighing in at 43 lbs. The input of 65 watts on AM phone and 75 watts for CW will work anything in the world.

Oscillator Circuitry

It would be well to follow the block diagram of Fig. 1 to clearly picture the whole of the transmitter system and its component parts. The oscillator is the heart of the Ranger II. Separate calibrated bandspread dial scales are provided for each of the seven bands and 6 to 1 ratio planetary drive mechanism results in excellent tuning accuracy and smooth control. The plexiglass dial is edgelighted. Ten kilocycle calibration increments on each band provide uniform and accurate dial interpolation. Although frankly not designed for frequency meter accuracy, checks with a 100 kc crystal oscillator will excite your admiration. The VFO employs a series tuned Colpitts circuit with a 6AU6, using two separate tanks. One covers the 1.75 mc to 2.0 mc frequency range and the other the 7.000 mc to 7.425 mc range. The VFO tank circuits and the output circuits are controlled by the front panel switch indicating the band of transmitter output. Temperature compensation, optimum circuit design, rigid construction and voltage regulation result in a high order of stability. There is freedom from "wobbulation" under modulation, or "yooping" when keyed. On the 160 meter and 80 meter bands, the VFO output remains on the 160 meter tank. On the 40, 20, 15 and 10 meter bands the VFO changes to the 40 meter oscillator tank. On the 6 meter band, additional capacitors are switched across this tank to lower the VFO frequency to a harmonic relation to the 6 meter band and add additional "C" to the oscillator to enhance stability.

A 6CL6 acts as an isolation stage and broad tuned frequency multiplier when the VFO is used. During crystal oscillator operation, however, it functions as a hot cathode oscillator. Grid-block keying is employed for the oscillator, the 6CL6 isolation stage and an additional 6CL6 buffer-multiplier, utilizing a 12AU7 as the keying tube. This system is called "Timed Sequence Keying." To avoid adjacent channel interference, a wave-shaping filter is used in the 6CL6 circuits. To avoid chirp when the VFO is keyed, the 12AU7 permits the VFO to start before the 6CL6s conduct and continues oscillation until after the 6CL6s stop conducting. There is a VFO keyer adjust control which permits adjustment of the "hold" time in order to permit rapid CW break-in operation to suit the operator.

When operating break-in, a slight arcing at the key may be noticed in your receiver. This is not transmitted over the air, and may be eliminated by installing a 2½ millihenry rf choke in each key lead right at the key. On the lower frequency bands, the rf stages are sufficiently broad as to permit a change of frequency within a CW or Phone portion of a band by means of the VFO alone. Obviously this would be more difficult on 10 and 6 due to the size of the bands. For greater excursions, the dial marked "exciter," final dip and loading will of course have to be touched up. Practice will quickly indicate the degree of latitude in this respect that you will have for the bands you use the most. A "spotting" switch position permits you to observe your transmitting frequency without unnecessary radiation on the air and to "zero" in on a transmitting station.

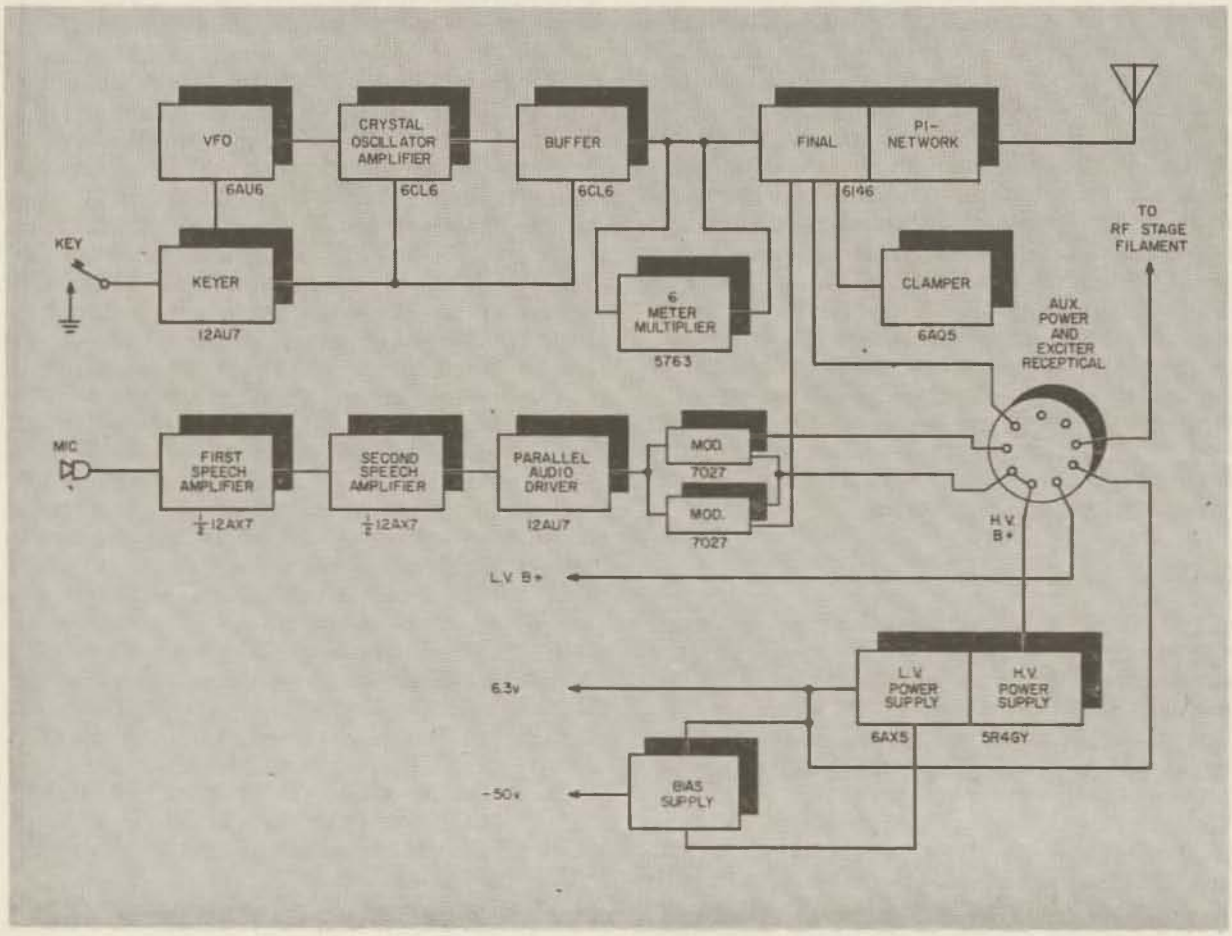
RF Circuit Operation

The 6CL6 stage used as a buffer-multiplier, mentioned earlier when the keying action was described, uses a tuned high Q plate circuit which is tuned to the same frequency as the final on all bands. Protection against excitation failure is derived from a cathode resistor. The band switch and coils are fully shielded to avoid any possible interaction, insuring clean circuit isolation and preventing instability. The output of this stage is controlled by a potentiometer which controls its screen voltage. This permits precision in adjusting final grid drive. An additional multiplier stage, not present in the original Ranger, uses a type 5763 tube. It is switched in to drive the 6CL6 buffer-multiplier when operation is to be on 6 meters.

The final stage uses a 6146 with a completely band switch pi-network of Hi Q design. The range of antenna impedances which may be matched on all bands is 50 to 500 ohms, plus the tuning out of a wide range of inductive or capacitive reactance. The range of antenna impedance which may be matched at frequencies above 7 mc extends, roughly, from 25 to 2000 ohms. The 6146 is protected from excitation failure by a 6AQ5 which is connected in shunt with it's screen dropping resistor. When excitation failure is encountered from any cause, the 6AQ5 conducts and lowers the 6146 screen potential to approximately plate current cutoff. The screen of the 6AQ5 clamper is connected to a voltage divider making the stage continue to conduct even at extremely low plate potential values. Under this cutoff condition the 35 to 40 ma current is indicated on the transmitter multimeter. It is not the plate current of the 6146 but is the plate current drawn by the clamper tube.

The Audio System

All triodes are employed in the speech and driver stages. The first and second amplifier is



the high gain 12AX7, ample for any crystal or high impedance dynamic microphone. A three circuit microphone jack is provided to accommodate the addition of a push-to-talk relay if PTT operation is desired. A 12AU7, parallel connected to a driver transformer is the source of low impedance drive for the modulator. The modulator, employing a pair of 7027 tubes in push-pull class AB can deliver more than enough audio for 100% amplitude modulation. Plate saturation limiting prevents large swings beyond full modulation thereby providing some limiting to reduce distortion and spurious output. The modulation transformer has a tertiary feed-back winding coupled to the grid of the audio power driver. This provides damping for improved regulation, stability and a flattened frequency response. This method also enhances the direct driving of external modulators when the Ranger II is used as an exciter.

The secondary of the modulation transformer is center tapped, to fill the requirements of an audio driver permitting it to work directly into the grids of external high power Class B modulators. The leads are filtered and by-passed, and made available at the exciter-auxiliary plug at the rear of the chassis. By using one half of the secondary winding, a nominal 500-600 ohm output can be obtained for driving large speakers used in paging or public address work. Thirty-three watts of audio are available at the output of the modulators for any application required. The frequency response range of the modulator section is flat within 3 db from 250 to 3000 CPS with a very pronounced roll off above and below these frequencies. The passed range is sufficient for pleasing quality yet confines the audio power within these frequency limits for a noticeable audio punch.

The Power Supply

This is a conventional dual plate voltage supply, employing a 5R4GY high voltage rectifier tube and a 6AX5GT low voltage rectifier. Choke input filtering is used in both supplies. The high voltage is 525 volts dc for the final and modulators, and the low voltage 320 for the rf exciter and low level speech stages. A 6AL5 rectifier for bias for the keying circuits and the modulator is fed from a third set of terminals on the power transformer secondary. If you want to power other equipment in the shack, you can use the rig as a power supply, from the exciter-auxiliary plug. In addition to the audio at this terminal, there is available 6.3 volts at 5.5 amperes for filaments, 300 VDC at 50 ma and 500DC at 210 ma. When the auxiliary plug is wired to tap off for external power, the complete rf section of the Ranger, including filaments, is de-energized, as the power supplies cannot provide the normal Ranger full power requirements and external power use simultaneously.

Specifications of the Viking Ranger II

Frequency Range: 160, 80, 40, 20, 15, 10 and 6 meter bands.

Power Input: 65 Watts AM Phone, 75 Watts CW.

Power Requirements: 105-120 VAC, 50/60 cycles, 260 watts.

Frequency Control: Integral VFO, or two switched crystal positions.

Utilization: All-round portable or fixed transmitter, RF Exciter, Speech or power amplifier, or power supply source.

Form and Price: Kit No. 240-162-1.....$249.50
Wired No. 240-162-2....$359.50

Maker: E. F. Johnson Company, Waseca, Minnesota.

Operation

The E.F. Johnson Company did extensive research when amateur radio first faced the threats of TVI. This is reflected in minute detail throughout the Ranger II. The cabinet is electrically sealed with flexible monel braid on the inside of the front panel and large cabinet overlap. A cup type shield seals the meter, and spring type contract washers on the front panel shafts prevent possible radiation from shaft clearance openings. The power line and relay jack circuits have double L type filters; all auxiliary socket, meter, dial lamp, key, and meter lamp leads are equipped with L filter networks. To minimize harmonics, interior harness leads and filaments are by-passed to the chassis. Careful by-passing of the final and design of the output circuit were aimed at reducing harmonics. This deep interest in TVI led to the investigation of causes beyond the well engineered transmitter. Improper grounding in the shack, as well as improper impedance matching, turned out to be another major source of trouble. This affliction troubles many an installation, regardless of the equipment, so if you are one who is being so deviled, beg, borrow, steal or buy a Viking Ranger II Operating Manual. There is a great deal of common sense procedures within it which could be applied to your shack, both on the subject of TVI prevention and proper loading and matching of your antenna system.

One panel meter serves as a multimeter, providing ample indictation of tuned circuit operation, switching between oscillator, buffer, grid, final plate and modulator. The manual tuneup instructions are a little confusing in that when told to tune the "buffer" your control is marked "exciter" on the panel. I would have preferred a slightly different turn-on, turn-off sequence in mode switching, but I

guess you can't please everyone in every detail.

Putting the equipment on the air was revealing. I had a warmed up BC-221 and a 75A4 ready to check calibration, but had little to do since the VFO dial markings fell right into the slots they were supposed to. The first firing up was late in the afternoon on 75 meters, with the initial CQ answered by a chap two states away who said his xtmr had been on 15 meters, but I sounded so good on 75 that he bust his buttons changing bands to call. Equally flattering remarks were produced on six and then the other bands. With scope and panadaptor on, the bug contacts were polished up, but no fault had shown up there either. The design and bugs on this equipment had been worked out so long ago that it might have been presumptious to hope to dig up flaws thousands had been unable to find. The unsolicited flattering remarks were in themselves outstanding. I even tried to QRM my color TV receiver on 3.579545 mc with no luck!

There is the Ranger II for you. It covers a whale of a lot of amateur bands in a day when many people specialize in just one of them. It gives you long or short range communications to fit any geographic requirement or environment or skip, and is a good basic piece of equipment to use as a standard for the measurement of other gear which you can be sure will be hard put to meet it. . . . W4API

Zerobeatnick

Gus Gercke K6BIJ

THE main difference between an expensive modern receiver and a cheap old one is:

1. Stability of its oscillators.
2. Price.

If, while listening to a *good* SSB station (be sure it is not just someone talking thru a garbage disposal unit), you have to retune every few minutes to take the "Donald Duck" out—you better meet Zerobeatnick.

Z-B is just a transistor oscillator used to zero-beat the incoming signal at its frequency (or a CW signal a little off its frequency), and mix with it *in the front end* of your receiver with your BFO off.

Z-B does not drift, as it does not generate any of its own heat (it operates on 1 ma 3v), it does not pick up heat generated in the receiver (separate box), and it works into a constant "load"; you can leave it for hours on a SSB group and watch *them* drift in all directions. The drift of your mixer oscillator is still there (BFO is OFF), but all it can do now—is cause the signal to get weaker; you cannot change the voice pitch, using your receiver controls, even if you want to do so (remember the BFO is off).

There is only one trick in using Z.B.: to be effective it must supply a signal of about the same strength* (at the point of mixing) as the signal you are listening to.

The mixing point can be the antenna terminal, or some point on your rf or mixer stage, and will differ from receiver to a receiver. It must be found experimentally, as too much input will result in a blocking action (only very strong signals will get thru); too little input will cause only weak SSB signals to sound normal, strong ones will sound as SSB sounds with BFO off.

There are dozens of transistor oscillator circuits, I used just one of them, you may find a better one.

With the 2N169A use fundamentals on 80 & 40 and harmonics higher, you may raise the voltage to 6 or 9 volts if you need higher output.

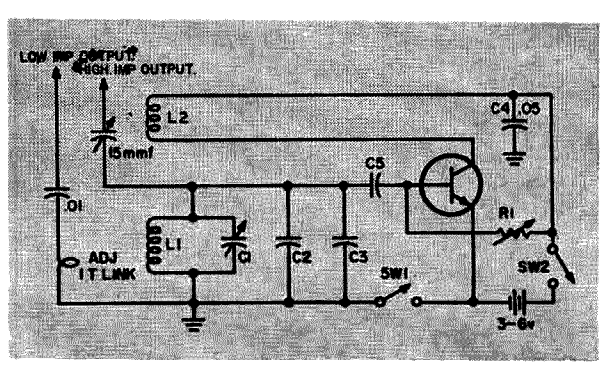
In some cases you will be able to use your VFO as a Z-B, this will give you an additional advantage of staying on another guy's frequency (or drifting with him) during a long listening period.

. . . K6BIJ

*Ratio of about 1:5 is acceptable.

Parts List

SW1—OFF: for 40M (C1 covers the band).
Om: for 80M (use iron slug to cover band).
Set **R1** for smooth regeneration over both bands. This can be a screwdriver adjustment.
L1—3 turns #18, ½" long on a slug tunes coil form.
L2—5 turns #24 over L1.
C1—365 mmfd variable.
C2—Bunch of silver micas totalling about 2000 mmfd.
C3—Same, about 8000 mmfd.
C4—.05 mfd disc ceramic.
C5—100 mmfd mica. or ceramic.
R1—½ meg pot.



A High-Level Frequency Converter

Carl C. Drumeller **W5EHC**
5824 N.W. 58th Street
Oklahoma City **22**, Oklahoma

ONE OF THE problems confronting the user of SSB equipment is how to get it on another frequency. Of course if it is a factory built job, probably the manufacturer took care of that little task. If it's a homebuilt exciter, the constructor has a job on his hands.

It's not that there is no literature available on frequency converters. Far from it. But all these frequency converters have one thing in common: They require first that the signal to be converted be reduced to the milliwatt range. If the exciter has a milliwatt output, this is no problem. But what of the exciter unit that you so proudly built to put out 20, 30, 50 watts? Are you going to tear out the amplifier section and start all over again? Or are you going to soak up all those hard-fought-for watts in a swamping resistor? Dry your tears, son; there's a way to make those watts earn their keep.

Let's see how we can put watts to work in a frequency converter. First, though, we need to establish a line of reasoning. Unless one has done a bit of thoughtful study of the subject, not many of us are prepared to equate a converter to a modulator. This being a construction article and not a treatise on theory, it would not be in order to take up the proof of that statement. If you're one of those hard-to-convince souls who must have proof, read Chapter 10 of Carson's Principles of Applied Electronics, published by McGraw-Hill. Now that we've convinced the skeptics, let's get into the job of planning the construction of a modulator . . . ah, that is, a frequency converter.

First, let's review the types of modulators available for use. There's the plate modulator. It requires the modulating frequency to be inserted in the plate circuit, effectively in series with the dc power supply and also in series with the rf output tank. We note these items and consider the next in line, control grid modulation. This has the modulating frequency in series with the dc grid bias and with the rf input tank. Again we make mental notation and progress to a third type, the suppressor grid modulator. This is more simple, requiring only that the modulating frequency be in series with the dc suppressor grid bias supply. It has just one nasty aspect: tubes with suppressor grids brought out to external connections and with suitable suppressor control characteristics are not in bountiful supply in the average amateur's junk box. Let's regretfully pass this system by and consider another, cathode modulation. This is a beast, partaking of all the disadvantages of both control grid and plate modulation while possessing none of the advantages of either. With a wry face, we bury this in File 13 and go on to consider screen grid modulation. Ah, this has promise! It asks only that we insert the modulating frequency in series with the dc screen grid supply. Better still, many common tubes have very excellent screen grid control characteristics.

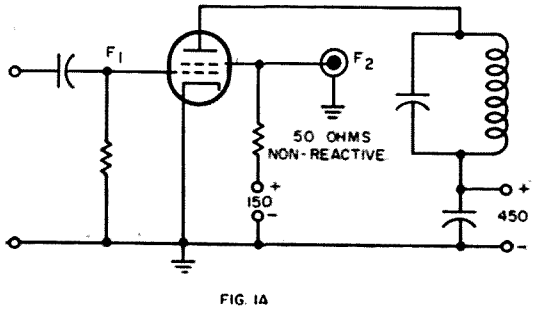


FIG. 1A

Having picked out what appears to be the most promising form of modulator, we next take up the problem of how to squirt that modulating frequency into the screen grid. There are many ways it can be done, but we're looking for the lazy man's way. The problem is somewhat complicated by the fact that we're going to be modulating with rf and not af.

We could do it with a tank circuit, tuning the tank to the modulating frequency. This has disadvantages. It requires an extra control, one that must be precisely adjusted to exact resonance if it is to offer a non-reactive load to the exciter (and we very much want just such a load). Then, too, if such a tank is used with either control grid, cathode, or plate modulation, we have the very nasty situation of two tanks in series, which can engender lovely headaches springing from interaction

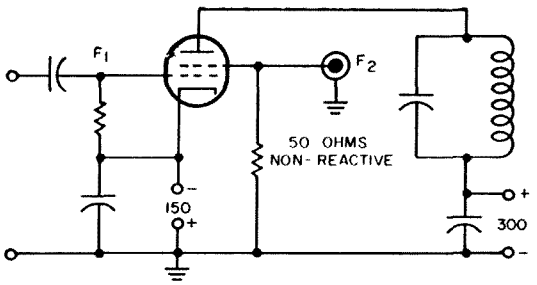


FIG. IB

effects. That's why we skitter away from these three types of modulation.

Having ruled out tank circuits, what remains? There is our old friend, the resistor. Ah, but that consumes power, you cay. True, but maybe we can put a byproduct of that power, voltage, to work. Let's get into a very minimum of theory to see how this can be done.

There's an old, familiar formula that says W equals E square divided by R. With a bit of juggling, we rewrite that as saying E equals the square root of W times R. Now lets' drop in some figures in place of letters and grind out an answer For R, let's use 50 ohms, that being the load that 99% of the exciters like to "look into." For W, let's take 50 watts, that being the power output of most of the 100 PEP watt exciters commonly used. Also, to be real sneaky about it, it simplifies our solution, for the square root of 50 times 50 is 50. This fifty, of course, is the RMS value of E. We'd like, however, to deal in terms of peak voltage, not RMS; so we multiply the 50 by 1.414 and come up with 70.7 volts. At the same time we make a mental note that this means a 141.4 peak-to-peak voltage.

Now let's see what we can do with this voltage. We can use it to vary the control function of the screen grid, and that's what we're intending to do. A quick review of the screen grid control characteristics of tubes likely to be found in one's junk box (807's 6L6's, 1625's, etc.) reveals that this control function is quite linear over a restricted range above and below the operating point of 150 volts. We'll select, then, 150 volts as our operating point.

This is the point to take time out for a small lecture. Screen grid modulators used in most homebuilt and all factory built amateur transmitters can give acceptable audio quality . . . if one is very charitable about what he classifies as "acceptable." Let's have no rosy illusions, however, about the absolute excellence of this modulation. The sad facts are that it is far, far from being linear when it goes beyond 50% or 60%. This generates several forms of distortion, of course, but we poor mortals, conditioned by years of listening to squeaky broadcast receivers, think nothing of 30% distortion. In fact, we call it good. A spectrum analyzer, however, is not as charitable as our "conditioned" ears. And a spectrum

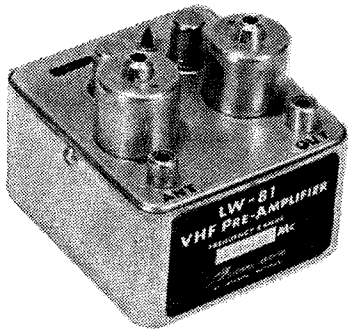
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analyzer is the thing that'll tell whether a frequency converter for a SSB signal is good or just plain junk. The point of this little lecture is that we can't get by with just so-so linearity in this modulator; it must be good.

Now back to our construction. Figure 1a illustrates a possible means of getting the output of the SSB exciter into our modulator. There is one glaring fault. If we fed the rf into it with a coax cable (as we'd like to), we'd short-circuit the 150-volt screen supply. Rather than have fireworks, let's slip that 150-volt power supply over into the cathode circuit, as shown in Figure 1b. This not only enables us to feed the screen with a grounded coax but places the 150 volts in series with the plate supply voltage. We now can use a lower voltage power supply for the plate.

Now that we've got our modulating frequency into our modulator, let's consider some other aspects of the circuits. In an af modulator we'd have rf going into the control grid and a composite signal present in the plate circuit. What makes up that composite signal? The original rf signal fed into the grid, the af modulating signal fed into the screen grid, the sum of these two frequencies, and the difference between these two frequencies. As there is a tank circuit tuned to a radio frequency as the sole load circuit for the stage, there is no load into which the af components can develop power. We'll forget them, then. The original radio frequency fed into the grid appears in the plate tank circuit as the "carrier." The sum of the audio frequency and the radio frequency appears in the plate tank circuit at the "upper sideband." The difference between the audio frequency and the radio frequency appears in the plate tank circuit as the "lower sideband."

The same conditions apply to our modulator in which the modulating frequency is a radio-frequency signal, not an audio-frequency signal! There is one small difference, however. That difference lies in the fact that, because of the high frequency of the modulating signal, the "sidebands" will lie far from the "carrier."

This might bear a bit of explanation, for it has an important bearing on both our plate tank circuit tuning and on the amount of rf power present in that tank circuit.

Consider the condition in which a pure rf (single-tone modulation of the SSB exciter) is present in the screen grid modulating circuit. Let's call this F2 and call the rf signal fed to the control grid F1. These may be quite widely separated in frequency. Now, in the plate circuit (plate circuit, not plate tank circuit), there will be present F1, F2, F1 + F2, and F1—F2. All four of these are radio frequencies, capable of producing rf power when fed into a suitable load. The load, of course, would be a tank circuit tuned to the desired frequency. Therefore we tune the plate tank circuit to the frequency (F1 + F2 or F1 — F2) that we desire and hope feverently that we have rejected the other three! Don't delude yourself, though; you'll never get that desired rejection with just one tuned circuit. You may well resign yourself to the stark necessity of having a multiplicity of tuned circuits in order to come up with the signal you want and no extra frequencies tossed in "for free."

Now you've got a signal on the desired frequency. Your first reaction, probably, will be one of disappointment as to its amplitude. After all, you've observed the magnitude of the rf coming out of a similar modulator fed with an af modulating frequency. Ah, but there's a difference! When you modulated with af, the "sidebands" lay so close to the "carrier" that the plate tank circuit tuned all three of them at once! Now, you may recall, you are rejecting the "carrier" (that hulking brute in which a very large percentage of the rf power lies) and one "sideband." The remaining "sideband," the one you've selected with your plate tank circuit, has a right to appear "puny" when compared with all three lumped into one. Relax, pal, you've got all the rf power that's rightfully yours. It's enough to tickle the grid of a very man-sized Class AB_1 rf linear power amplifier, too!

If you're ready and eager to reach for a soldering iron, Figure 2 will show you a few pointers. The box labelled 11.1 mc exciter contains very conventional circuits; no need to take up space with them. Its sole purpose is to

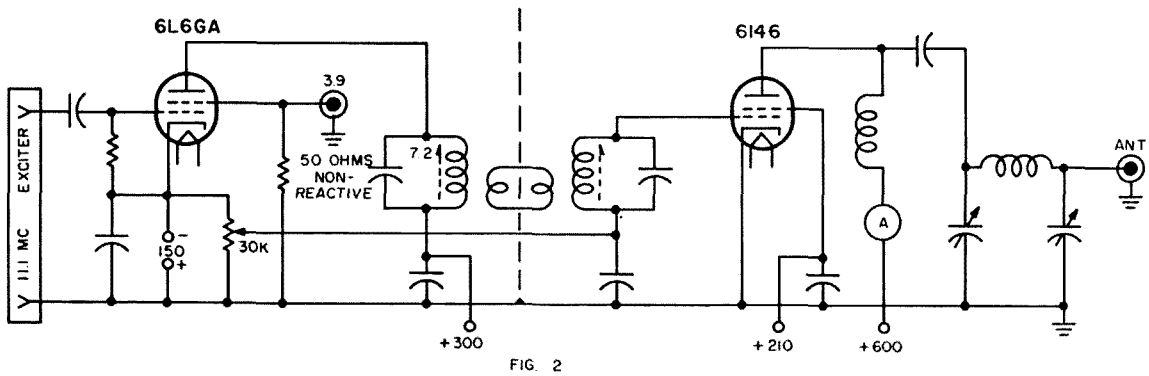


FIG. 2

produce F1. Note that F1 feeds into the grid of a 6L6GA. Into the screen grid of the 6L6GA comes the 3.9 mc output of your SSB exciter. Assuming it to be 50 watts, the 70.7 (peak) volts developed across the non-reactive resistor varies the screen grid potential from 150.0 — 70.7 = 79.3 to 150.0 + 70.7 = 220.7 . . . all voltages well within the linear portion of the 6L6GA's screen grid control curve. In the plate tank circuit, we pick off F1 — F2 = 7.2 mc. Just to play safe, we link-couple to a tuned grid circuit for the next stage. By using plenty of C in each of these two tanks we arrive at a total Q (Qt = Q1 Q2) that is high enough to discriminate against F1, F2, and F1 + F2. The output stage is a conventional Class AB_1 linear amplifier. Although a tube in the 6146 class is indicated in the diagram, the rf drive available is sufficient to excite a much larger tube.

Should you wish to use a 3.8 mc exciter on 14.2 mc, you'd select 18.2 mc for F1. If you have an "all-band" (3.5 to 29.7 mc) exciter that you want to put on 50 mc, you'd select 49 mc for F1 and use the 21 mc output of your exciter for F2.

You may wonder about the lack of detail in a "construction" article. It was deliberate, being based upon the author's opinion that no radio amateur needs to be told every component value, every wire's position, every tube's location in a piece of equipment to be built. If one does, he should engage in some serious introspection to determine whether he is an amateur of radio or an amateur of talk-over-radio.

Test Lead Tip

Many vacuum tube voltmeters are equipped with banana jacks for the "OHMS-AC" and "COMMON" test leads. These leads often pull out of the jacks and are a constant source of inconvenience. This is particularly true if the disconnected lead is not noticed and time is spent attempting to reconcile inconsistent meter readings.

The answer to this problem is simple. Remove the instrument from its case and discard the banana plugs which are attached to the test leads. Thread the leads through the jacks, tie knots in the leads to serve as strain reliefs and solder the leads to their respective receptacle lugs.

Replacing the leads is not the problem it would appear to be. Good quality, live rubber test leads (you should tolerate nothing else.) will last for years. Even if you are careless enough to lay a 200 watt soldering iron across the leads, replacement only takes a few minutes and affords a good opportunity to perform a little preventive maintenance on the instrument.

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Modulation

Staff

ALL of us, as hams, know the importance of modulation. Some of us go to great lengths to avoid its problems; others go to equally great lengths to take fullest advantage of its possibilities. But none of us, at any time, escape it.

For modulation, you see, is inherent in every act of human communication — whether by radio, the printed page, or a flirtatious wink!

One of the classic scientific books on modulation theory opens with the phrases: "Boy winks. Girl smiles. That's modulation in action." And while it may seem a far cry from single sideband or RTTY, the statement is completely true.

What's more, it hammers home the point that modulation, in essence, is *any* process of communicating information by modifying existing energy which does not, in itself, carry the information. The wink, for instance, caused a modification of the reflected light rays seen by the girl, and communicated the message, "I like you" or a similar thought.

While flirtatious winks are frequently interesting, our main purpose here is to explore the subject of modulation as applied to ham radio, so let's restrict the definition of the word a little bit: "The modification of a radio-frequency signal to transmit information."

Now, if we look closely at the classic picture of a radio-frequency signal, we will discover that it has only two characteristics which may be varied: its amplitude and its frequency. These two characteristics completely define the signal, and since either of them may be varied to transmit information this immediately leads us to the two major forms of modulation: amplitude modulation (which we will *not* abbreviate in this article for reasons which will soon become clear) and frequency modulation.

If you re-read that last paragraph you'll also see that no other basic forms of modulation are possible; actually, many more types exist, but all of them are variants of the two basic forms.

A possible exception is pulse modulation, which is concerned not with a steady rf signal but with an intermittent signal. The timing of the intermittent signal provides a third characteristic which may be varied. However, from a slightly different viewpoint both amplitude- and frequency-modulation processes may be considered as pulse modulation (if you think of each half-cycle of rf as an individual pulse) so it's not so much of an exception as it might appear at first.

About here we ought to break the two basic forms down into the more commonly known types, and make the point that CW is a form of modulation also.

Amplitude modulation includes CW, known to the FCC as type A1 emission; phone (commonly called AM, an abbreviation which we'll avoid for the sake of nonconfusion) or A3; and television or A5. It also includes AFSK (type A2), MCW (also A2), and facsimile (type A4).

Frequency modulation includes FSK or type F1, phone or type F3 (which may be called FM, NBFM, PM, or NBPM also), and facsimile (type F4).

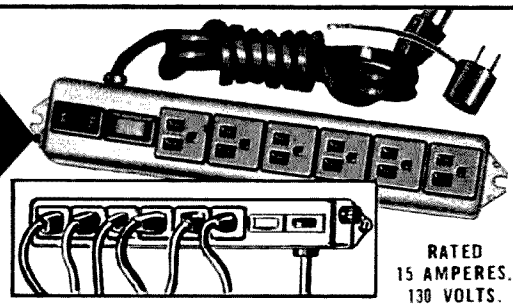
Let's look at these classifications a bit more closely.

CW transmission is familiar to all of us, but the concept of CW as a type of modulation may not be so familiar. However, consider a special kind of modulator which allows the transmitter to produce full output when the modulating signal is present and cuts off all output when the signal is absent. For the modulating signal, use a square wave which drops to zero on negative peaks. The output signal will be a string of dots—and nothing more.

Approaching CW as a special case of amplitude modulation allows an easy handling of key clicks, chirp, and other keying problems which can be most confusing in the conventional approach. We'll come back to this later when we examine circuits.

Phone transmission is what we all think of when "AM" is mentioned; however, there are many forms of A3 emission. The most conventional is DSB plus carrier. Also included are DSB without carrier, SSB with carrier, and SSB without carrier. While the circuits for producing these various types of A3 differ, the classification does not.

The difference between A3 and A5 (television) is primarily one of bandwidth. While distortion-free phone conversations can be transmitted in a 10 kc bandwidth, it requires something like 6 megacycles to handle an A5 emission with the same clarity. The bandwidth problem forces different circuits into play also.

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The differences between A2, A4, and A3 are mostly a matter of degree. A2 is a cross between A1 and A3, while A4 is a cross between A3 and A5. In either case, the common circuits apply.

How about frequency modulation?

Type F1 emission, frequency-shift keyed telegraphy, is used primarily by RTTY operators. It corresponds roughly to A1 or CW transmission, except that where CW uses a coded combination of the signal's presence and absence to convey information, FSK uses a coded combination of the signal's presence on either one frequency or another to convey the information. Since the signal must always be on one or the other of the frequencies used, the system is fail-safe — if the signal disappears entirely, you know for sure that something has happened to the transmission. You don't have to wonder if the guy at the other end is trying to think of something to say.

Type F3, as mentioned earlier, has many names. Its major subdivision is into FM and PM, abbreviations for frequency- and phase-modulation, respectively. However, no essential difference between the two processes exists. In a pure FM system, the actual output frequency is controlled by the audio signal. In a pure PM system, the rate of change of the output frequency is the controlled element. In broadcasting practice, the "FM" signal ranges from pure FM at one end of the audio spectrum to pure PM at the other, with a Heinz mixture in between. The prefixes "NB" and "WB" mean, respectively, narrow-band and wide-band. For ham use, narrow-band means a bandwidth not greater than 6 kc, while wide-band means any bandwidth greater than that.

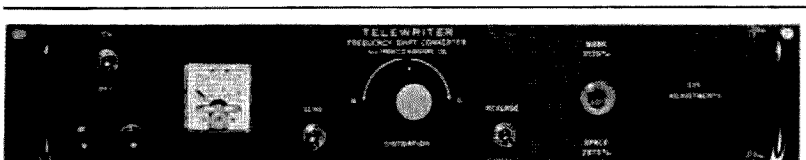
Type F4 is seldom used by hams and is included merely for the sake of completeness. It bears the same relation to type A4 that F1 does to A1.

While we're looking at modulation systems in general, let's take a swing through the field of pulse modulation.

The basic difference between pulse modulation and the other forms of modulation lies in the nature of the *unmodulated* signal. In more-conventional types of modulation, the unmodulated rf signal is a steady "carrier," constant in both frequency and amplitude. However, with pulse modulation, the unmodulated rf signal consists of a series of brief pulses of rf energy. Timing of the pulses, frequency of the rf signal emitted, and amplitude of the pulses are all constant.

Pulse modulation offers a number of advantages over the more-common modulation processes, as well as possessing a number of disadvantages.

One of the greatest advantages is that it allows much more rf power to be transmitted; this comes about because power is a quantity which exists only with respect to time. A steady rf signal such as is used in the more-common forms of modulation has a "power" which is equal to the power produced by a certain amount of direct current *in a given period of time.* This is true even though much of the time the instantaneous voltage is near


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zero.

To illustrate this point, let's look at a signal with a rms power of 100 watts. That means that the signal's power is equal to that produced by 100 volts of dc flowing at a current of 1 amp. But 1 ampere is defined as 1 coulomb of electric charge moving past a given point in 1 second. If 10 coulombs of charge were moved past the point in 1/10 second, and no charge moved during the other 9/10 second, the current would still be 1 ampere.

Let's go even farther. Let's allow the charge to move for only one one-millionth of a second. To get that one ampere now, we have to move a million coulombs of charge. During the millionth-of-a-second that the current flows, the instantaneous power is 100 million watts. During the rest of the time, instantaneous power is zero. But by the definition of current quoted above, the power flowing over a two-second or longer time is still just 100 watts.

We've been talking about dc. The same treatment, though, applies equally well to rf energy. By concentrating the rf output in pulses one microsecond long and sending only one pulse per second, we can shoot 100 million watts out of the antenna with a 100-watt transmitter—and be perfectly legal about it all.

While we're talking about advantages, let's also mention that some types of pulse modulation offer a signal/noise ratio of infinity; that is to say, if the signal can be detected at all, it will have a noise level of zero.

But with the advantages come disadvantages. To transmit these pulses without distorting their shape requires lots of room. To transmit the microsecond-wide pulses we talked about a few paragraphs ago will take about a megacycle of bandwidth — which means more rf spectrum space than the entire 80 and 40 meter bands put together! For this reason, the FCC limits pulse transmission to the uhf regions and above.

The increased bandwidth required also hurts the signal/noise ratio at the receiver, just about balancing out the power advantage gained. In other words, the same tube will give you about the same range with either pulse or conventional modulation when operated at the same *average* power level. The advantages gained by the signal/noise ratio = infinity types of pulse modulation are somewhat offset by the complexity of the circuits involved.

The net results is that pulse modulation still appears promising for use at uhf, because it's easier to get going at 1215 mc and above than is the equivalent amount of power with conventional modulation—but results with the two types of modulation under best conditions will be about the same.

After this general introduction to pulses, let's look at the specific types which make up pulse modulation.

As mentioned earlier, pulse modulation involves not just two but three characteristics of the rf signal which may be changed to transmit information. These characteristics are the pulse amplitudes, the pulse timing, and the pulse width.

Pulse amplitude modulation is similar to ordinary amplitude modulation, in that pulse amplitude is directly proportional to the value of the modulating signal.

Pulse timing gives rise to "pulse position modulation," abbreviated PPM, in which all pulses are the same amplitude and width but their position with respect to each other changes in accordance with the modulating signal. Since only the timing is important, noise has little effect (the pulse may be "regenerated" before detection, so that no noise reaches the detector).

Pulse width modulation (sometimes called pulse duration modulation and abbreviated PWM or PDM) is similar to PPM except that the pulses all start at the same time with relation to each other but their width is controlled by the modulating signal. Like PPM, noise may be eliminated by "regeneration."

PAM is roughly equivalent to conventional amplitude modulation, PWM is equivalent to FM, and PPM has no direct equivalent in conventional terms but is a cousin of FM. The fourth class of pulse modulation has no relative at all among conventional systems, and offers the greatest noise freedom possible (at the expense of added circuit complexity).

This fourth class is pulse code modulation, abbreviated PCM. In PCM, the modulating signal is sampled at a regular rate. The instantaneous value of each sample of modulating signal is converted to a binary-number code, and this code is transmitted. Thus, the signal actually transmitted bears no obvious relationship to the modulating signal — you must know the code to receive it.

Since pulses can be "regenerated" along the way, the code signal will not be distorted by

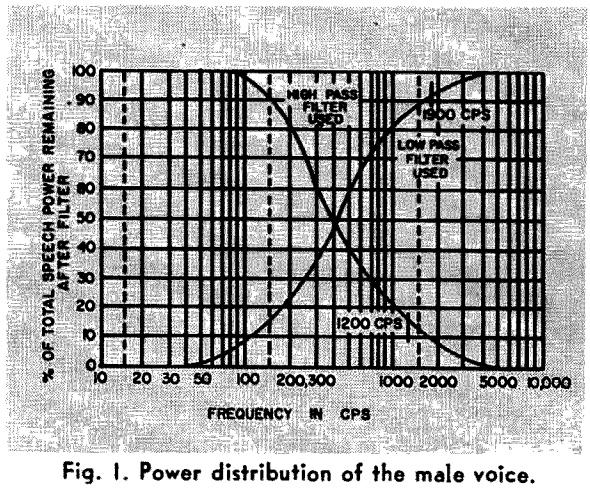


Fig. 1. Power distribution of the male voice.

any transmission conditions, and at the receiver can be used to reconstruct the modulating signal. Transmission-path noise never gets near the modulating signal at all; the only noise introduced is a type called "quanitizing noise" or "granularity," caused by the fact that the reconstructed signal is never a true replica of the original. The more characters provided in the code, the less this noise will be. Television signals can be transmitted with a 7-level code, but speech requires 256 levels of coding for "undistorted" reproduction.

So far, we've examined the entire field of modulation *processes* in general terms. Now let's look at the modulating *signal*.

In general, a modulating signal will consist of one of three forms of information: speech, visual material, or coded language. Speech needs no explanation. Visual material includes photos, typed, printed, or handwritten material, and live action such as television. Coded language includes "CW" coding, RTTY, and such lesser-used forms of coding as land-line Morse.

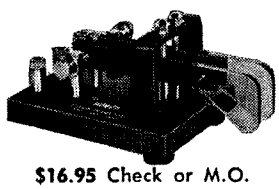
In any event, the modulating signal requires certain treatment before it can be used to modulate the transmitted output.

Speech exists as wavefronts in air. At the very least, these wavefronts must be converted to electrical signals by a microphone. However, telephone company studies have shown that a restricted bandwidth is sufficient to carry speech, and good practice requires that the bandwidth be restricted as far as possible to conserve space in the bands.

For many years, the magic figures of 300 and 3000 cycles per second have been taught as the lower- and upper-frequency limits for adequate intelligibility. We ourselves fell into this trap in an earlier technical article ("How Low the Fi," June, 1961). However, study of the actual curves published by Fletcher and republished by many others shows that the audio bandwidth can be restricted much more without hurting the transmission of information.

Figure 1 shows the average power content of human speech. Figure 2 shows the loss which results when the bandwidth is narrowed. Note that intelligibility suffers comparatively little when the frequency range is restricted to the band from 1200 to 1900 cps, but power content is reduced drastically. This means that modulator power may be increased

(Turn to page 78)



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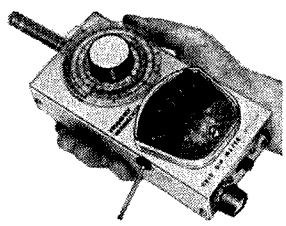
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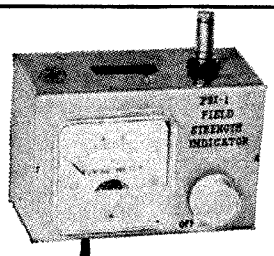
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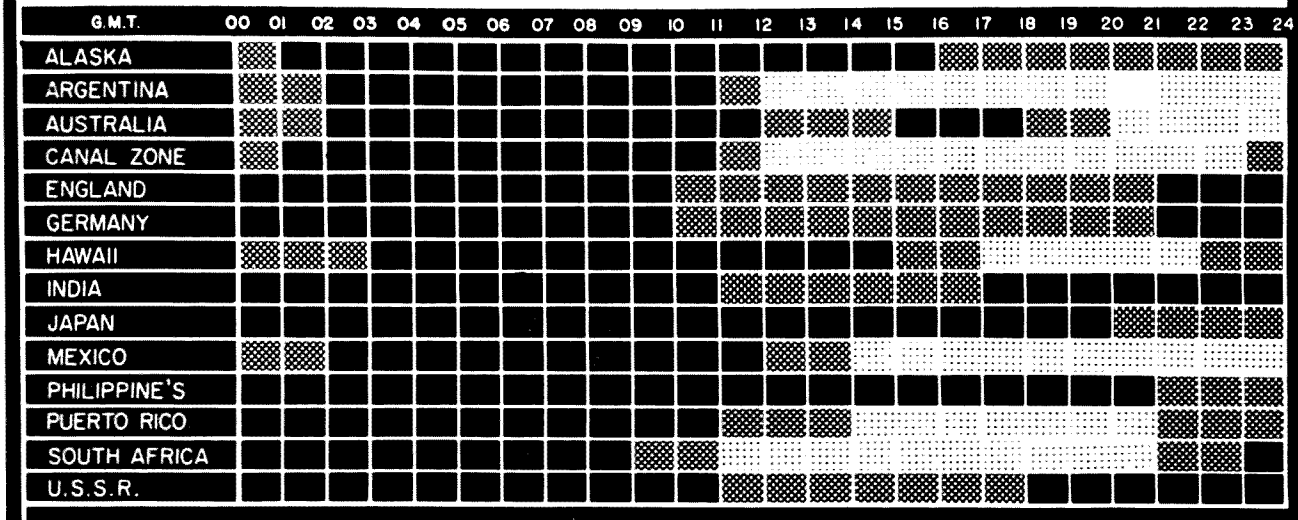
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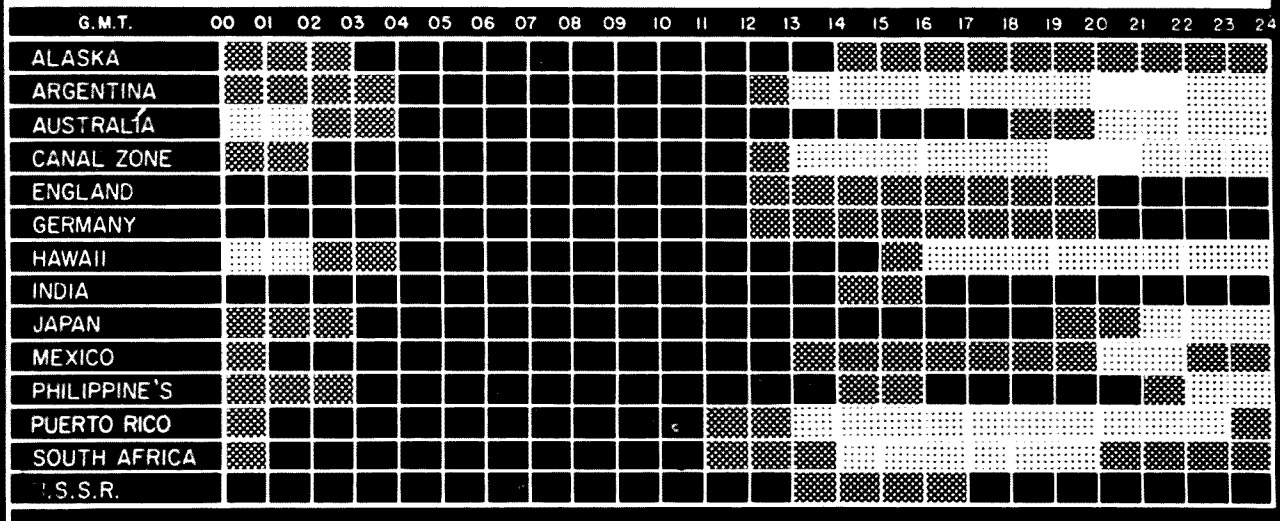
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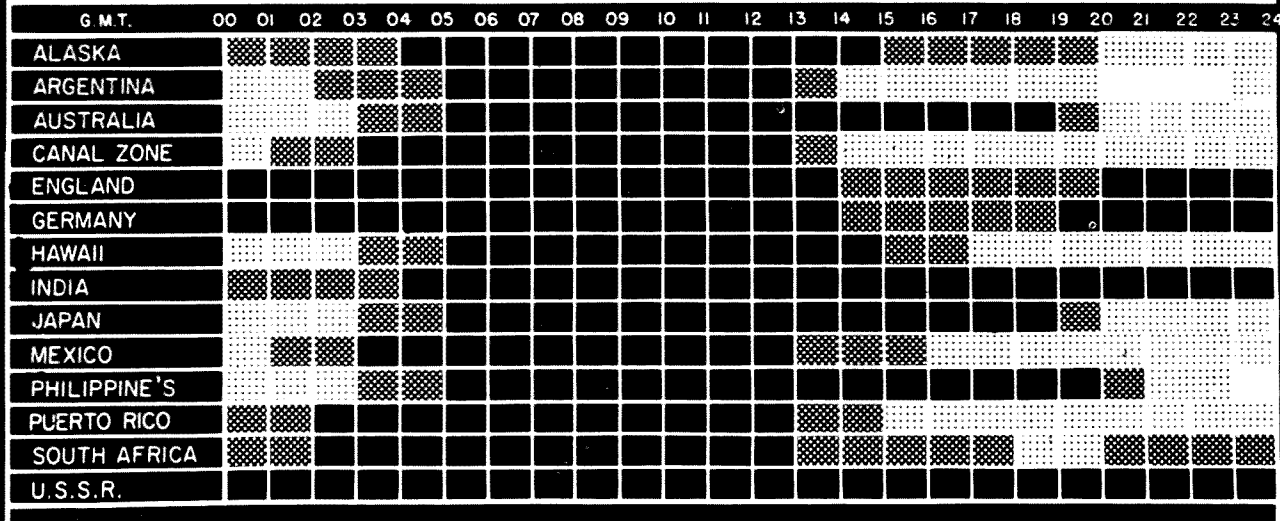
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For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HFB will not work and a lower HFB sometimes will work, but not nearly as well. The time is in GMT, not local time.

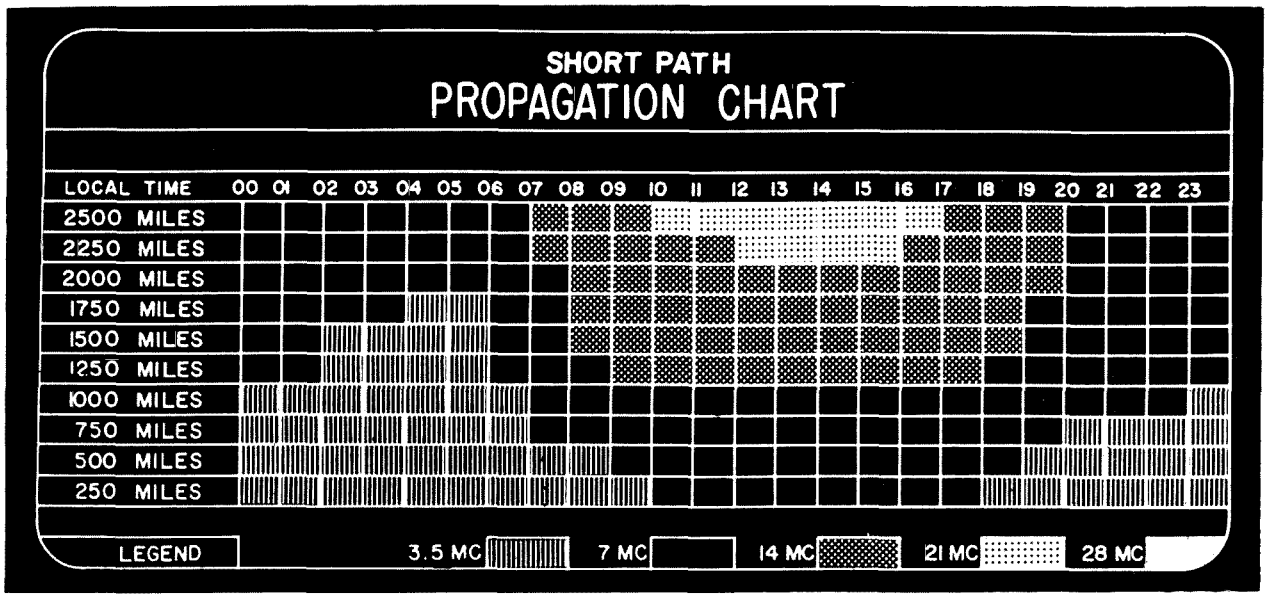
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Good: 1-23

Fair: 24-27, 29-31

Bad: 28

The Short Path propagation chart has been set up to show what HFB to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HFB to use and the time periods given will be the same at each end of the circuit. B.) To work the miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HFB to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.



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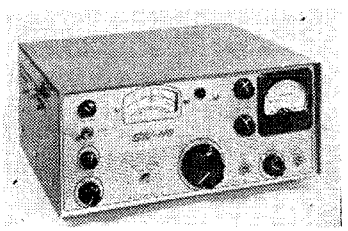
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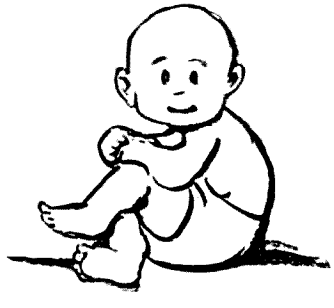
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(Modulation from page 73)

many times, giving more punch at the other end while maintaining bandwidth narrow.

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If you prefer to stay with the accepted frequency response limits, means of shaping the response of any speech modulator are shown in Figures 3 and 4. A narrow-band filter for cutting to the 1200-1900 cps range is shown in Fig. 5.

Transmission of visual material requires that the changes in light-wave intensity which make up the visual image be converted to electrical signals. For still-picture material, the flying-spot scanner is excellent. A circuit is shown in Fig. 6. This device operates by sweeping a spot of light across the picture in a predetermined pattern, and picking up the light with a photocell. Where the picture is dark, little light will reach the photocell and the electrical output will be small. If the picture is light, much light reaches the photocell and electrical output is large.

Transmission of moving visual material requires television techniques, easily an entire book in themselves. Several are listed in the bibliography.

Finally, we come to coded language. In practice, this boils down to "CW" and RTTY.

Most of us consider CW as a form of modulation all by itself. However, in a strict sense it is amplitude modulation with a two-valued

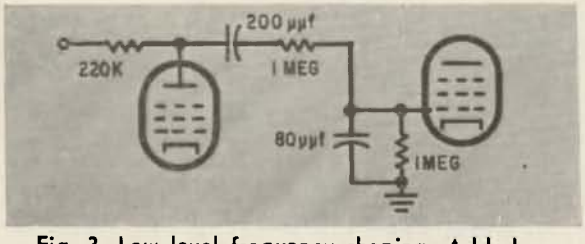


Fig. 3. Low level frequency shaping. Added or changed parts shown in heavy lines; change every R-C stage as shown.

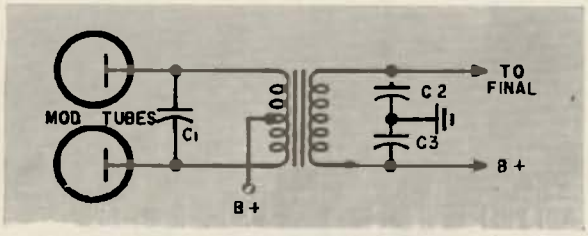


Fig. 4. High level frequency shaping. C1—.01 to .0001 mfd. choose by experiment. C2—existing bypass. C3—power supply output capacity. Note similarity to tuned if transformer.

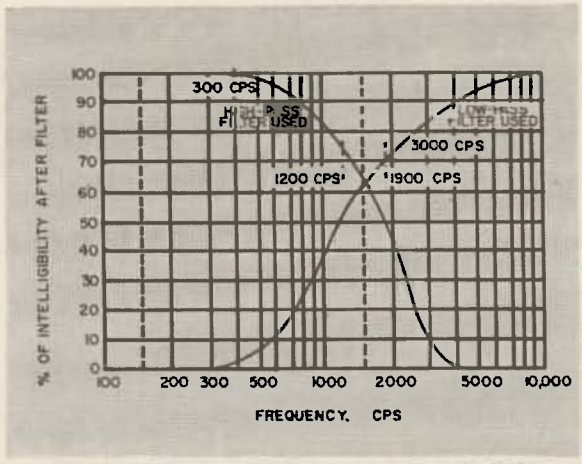


Fig. 2. Effect of filters on voice intelligibility.

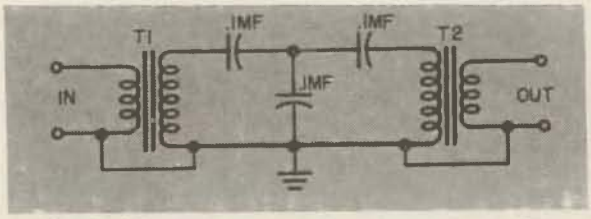


Fig. 5. Narrow band audio filter. T1 & T2—Stancor WC-17 width coils. Disconnect T1 & tune T2 for 1600 cps peak; disconnect T2 and tune T1 for 1600 cps peak; reconnect T2. Use low-Z drive and high-Z loading.

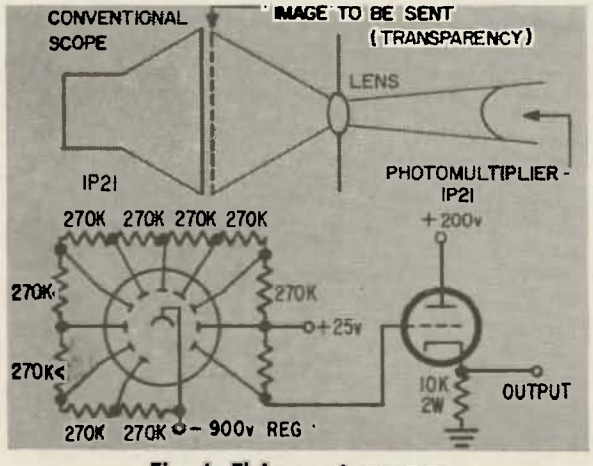


Fig. 6. Flying-spot scanner.

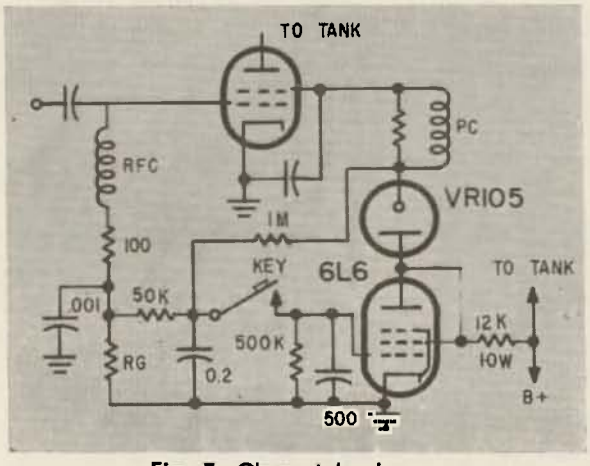


Fig. 7. Clamp-tube keyer.

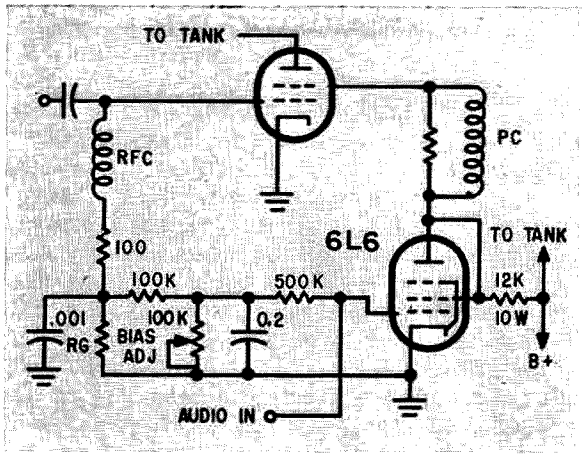


Fig. 8. Clamp-tube modulator.

signal. The major difference is that the signal is apparently electrical from the start. We say "apparently" because actually, it is not.

The signal starts in the mind of the originator. Using CW with a hand key, as an example, he decides to give his old buddy W2NSD a call. The signal begins as his determination to send the characters W, 2, N, S, and D in sequence. He consults his memory (most frequently at the subconscious level) for the code equivalents, and then converts the letters into electrical signals by pressing the key in the proper pattern to obtain didahdah dididadadah dadit dididt dadidit as an output from his monitor.

CW is amplitude modulation because the amplitude of the output signal is the characteristic that is changed. This amplitude is either maximum, or it is zero. The essential similarty of CW and A3 modulation may be seen by comparing the clamp-tube keyer, Fig. 7, and the clamp-tube modulator, Fig. 8. The only difference is that the keyer includes provision for reducing the output amplitude to zero when the input modulating signal is zero.

The major reason for bringing this discussion up is to describe a method for eliminating key clicks and other nuisances of CW operation, which may be visualized easily once the CW signal is seen as a type of amplitude modulation.

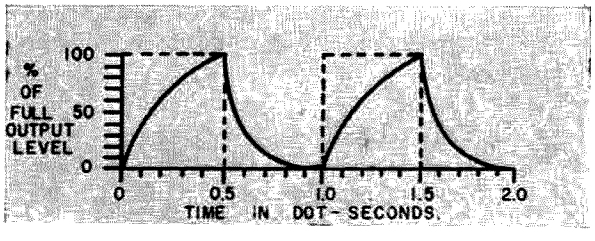


Fig. 9. Clickless keying waveform.

Since the CW modulating signal is binary—either on or off, with no in-between—it is essentially a square wave. By definition, a square wave is made up of a sine wave at the fundamental frequency, plus *all* the odd harmonics of this sine wave. Modulation

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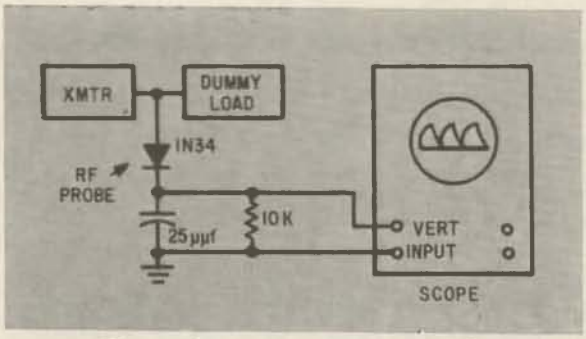


Fig. 10. Keying test set-up. Sync—internal; sweep—internal, 15 cps; key rig at 50-60 wpm.

theory tells us that a modulated signal must contain sidebands which extend as far from the carrier as the uppermost frequency of the modulating signal—and the "infinityth" harmonic of anything is infinity. This means that our square-wave keying will produce side frequencies which go out to infinity; these are the radiations usually called key clicks.

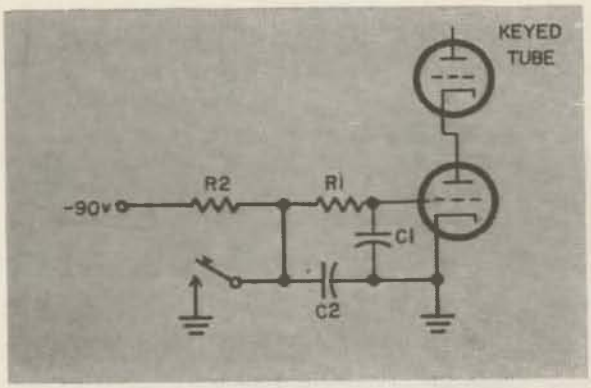


Fig. 11. Keying waveform shaping circuit. C1 and R1 control leading edge. C2 and R2 control trailing edge. Typical values: C1—.003 mfd. R1—1 meg., C2—.001 mfd. R2—1 meg.

Studies by W. A. Edson have shown that readability of a CW signal just begins to suffer when the square-wave modulating signal has been distorted to the point shown in Fig. 9. This waveform contains only the fundamental frequency, its third harmonic, and a trace of fifth harmonic. Thus, by adjusting the "modulator" (if you want to be conventional, that's the keyer stage) to produce this wave shape at the transmitter output from a string of dits, key clicks have been completely eliminated while readability hasn't been hurt.

If you have a scope handy, you can set up the shaping circuits without ever going on the air. Rig up the rf probe shown in Fig. 10, hook the transmitter to a dummy load, and send a string of dits while adjusting the keyer for a scope waveform like that shown in Fig. 9. A frequency-shaping circuit which may be used to get the proper waveform is shown in Fig. 11.

We've been talking about CW only for the last few paragraphs, but RTTY is also a coded-language form of modulation. Like television, it's a book all to itself. See the bibliography for references.

With the types of modulation and the modulating signal both well in hand, the only thing left to look at is the modulating process itself. This is where the circuitry comes in, since many ways have been developed to achieve each type of modulation and each way has its advantages and disadvantages. Let's look at them in order, with the advance warning that the collection is far from complete. The field is so wide and includes so many circuits that all circuits which are fully described in the two standard ham handbooks have been omitted from our listing, to leave room for some of the lesser-known arrangements.

Let's start with type A3 modulation, the conventional voice variety which ends up with two sidebands and a carrier. This output signal may be achieved through plate modulation, screen modulation, or cathode modulation. Plate, cathode, and several types of screen modulation are covered elsewhere, but the circuit of Fig. 12 seems to have been largely overlooked by the compilers of handbooks.

This circuit is similar to Heising or constant-current plate modulation (see handbooks for details of these) in that the dc current flow through the choke remains relatively constant. With no modulating signal, part of the current flows to the screen of the final and the rest flows through the modulating tube. When the modulating signal swings positive, the resistance of the modulating tube drops and more current flows through it. The choke opposes sudden change in total current, so the current flow to the final screen becomes less; since the dynamic screen resistance is unchanged, the drop in current causes a drop in voltage. The decreased screen voltage causes a decrease in power output. When the modulating signal swings negative, the opposite happens. More current flows to the screen, the voltage rises, and power output increases. If no-signal voltage levels are properly set, modulation will be linear. In practice, the

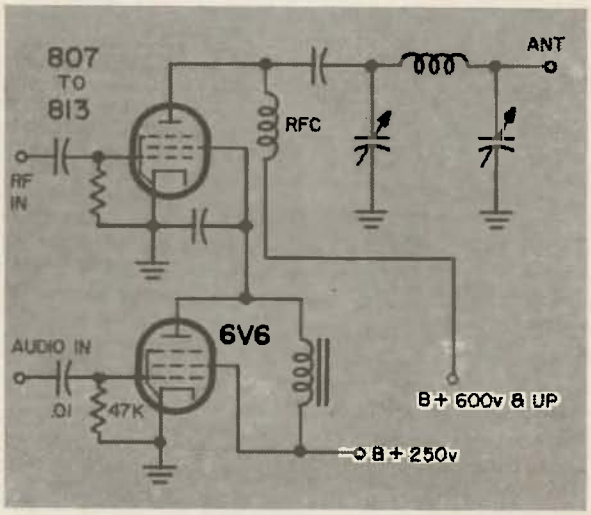


Fig. 12. Heising screen modulation.

system tends to adjust itself. Overmodulation is impossible since *some* screen current always flows. Like all screen modulation circuits, however, this arrangement is critical in drive and loading requirements, and gives only about 35 percent efficiency.

Another screen-modulation circuit not widely used is the one shown in Fig. 8, which differs from conventional clamp-tube modulators in that grid bias for the modulating tube is obtained from the final grid. Thus, the clamp-tube serves the same purpose for A3 that it does for CW in protecting the final tube in case drive is lost. Bias is adjusted for the most linear modulation, as determined by on-the-air or by scope tests.

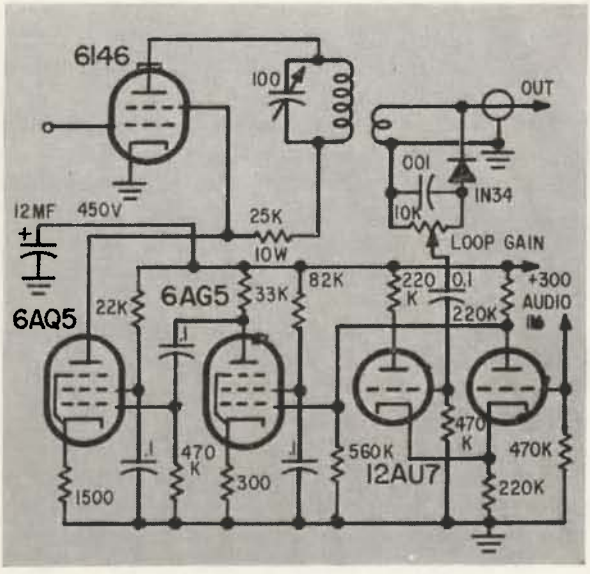
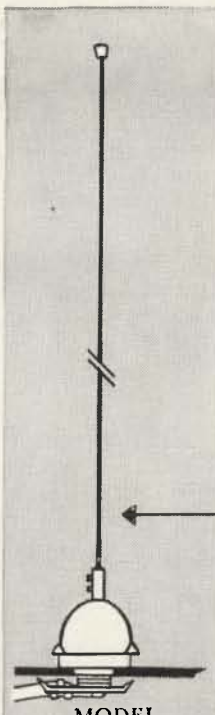


Fig. 13. Feedback modulation.

One of the great problems with screen, suppressor, and cathode modulation systems is lack of linearity. This can be overcome easily if we swipe a stunt from the hi-fi crowd and apply negative feedback to the modulator. The overall feedback connection is shown in Fig. 13. This uses a detector to pick off some of the radiated signal, then feeds the detected signal back in the proper phase to the modulator to eliminate any distortion. Linearity of such a modulator is inversely proportional to the gain within the feedback loop; if the total gain within the loop is 100, for example, modulation linearity will be approximately 1/100 or 1 percent. The circuit shown has a gain of 50, giving 2 percent linearity.

Another use of feedback is around the high-level modulator stage alone as shown in Fig. 14. This does nothing for the modulation linearity, but compensates greatly for the poor low-frequency response of most inexpensive modulation transformers and reduces distortion when heavy clipping and compression is used.

Single- and double-sideband circuits have been covered widely elsewhere, and at any rate deserve an article all to themselves, so we'll

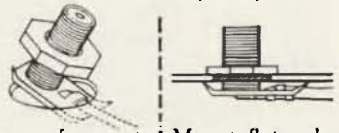


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merely take notice of their existence at this point before swinging over to the field of FM.

FM may be obtained in a number of ways. The most common among us hams is by use of a reactance tube to vary the frequency of a VFO, and this approach is covered in all the handbooks. However, at least four other practical methods are almost unknown in the literature.

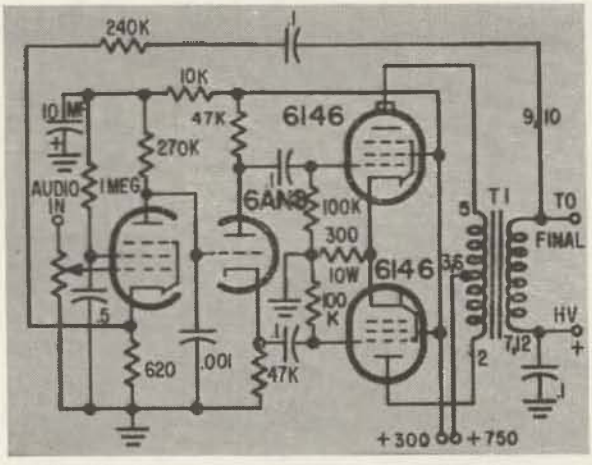


Fig. 14. Feedback plate modulator. T1—Stancor A-3893.

Most recent of these methods is that described in our October issue—the use of a voltage-variable capacitor across part of the tank circuit. The circuit is shown in Fig. 14. Hint—a Sarkes-Tarzian M500 rectifier hooked up in reverse (positive to cathode, negative to anode) does a fine job as a voltage-variable capacitor.

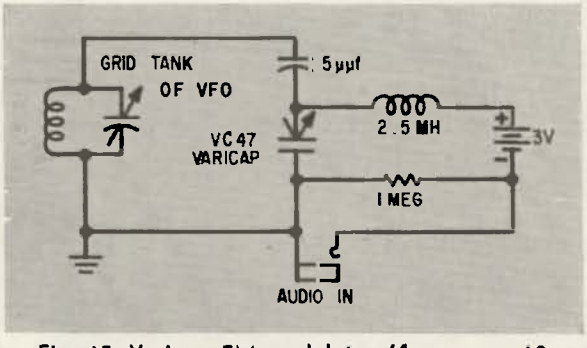


Fig. 15. Varicap FM modulator (from page 10, October '60, 73).

Similar, but much older, is the use of a ceramic capacitor for the same result. Certain ceramic dielectric materials change their properties according to the voltage across them, and the material used in the "Hi-K" series is one of these. By putting one of these capacitors into the VFO tank circuit as shown in Fig. 15 and applying high-voltage audio to it as shown, highly acceptable FM is produced.

Major Armstrong's FM system used still another approach, which is coming into ham use via several SSB exciters which include FM provision. His system used parallel chains of DSB and phase-shifted carrier signals, combined in such a manner that essentially pure

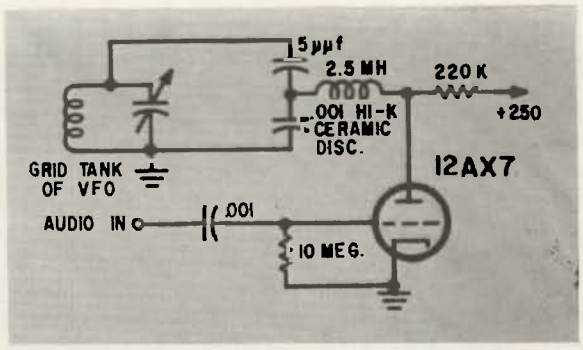


Fig. 16. Ceramic capacitor FM modulator.

phase modulation resulted. A block diagram is shown as Fig. 16. Since the schematics for such a system are highly detailed, they are left in the original references if you're interested.

The fourth aproach gives wider deviation than any other, but is limited to rather low carrier frequencies. It makes use of a multivibrator circuit rather than a conventional VFO, and varies the "on" time of one of the multivibrator tubes to vary the frequency. Since the multivibrator output consists of a fundamental sine wave and *all* its odd harmonics, this variation in "on" time corresponds to a variation of not only the fundamental but all the harmonics. The desired harmonic is then taken out through a bandpass filter, and amplified.

A schematic for such an FM modulation system is shown in Fig. 16. This operates at a basic frequency of 400 kc, taking off the fifth harmonic for an output frequency of 2 mc. This 2 mc output may then be multiplied up to the desired final output frequency.

In addition to the modulation changes, the basic frequency may be changed by varying the setting of resistor R1, thus allowing remote tuning without capacitors.

Enough for type F3; let's look briefly at type F1 before going on to the less-familiar pulse-modulation circuits.

With F1 modulation, we're concerned with only two frequencies, shifting from one to the other in accordance with the modulating signal. If you're using crystal control, the simplest way to do this is to add capacity in series with the crystal through a diode switch

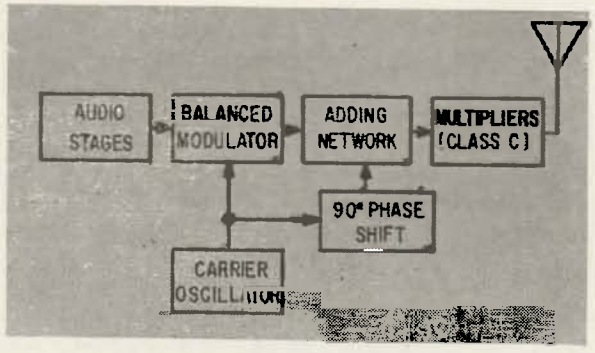


Fig. 17. Armstrong FM system.

as shown in Fig. 17. In normal operation, the diode and capacitor are effectively out of the circuit because the diode is back-biased. However, with modulating signal present the diode is forward-biased and conducts, connecting the capacitor into the circuit and changing the frequency by a pre-set amount.

F1 can also be obtained from a SSB exciter by the use of an audio oscillator keyed to change frequency, as shown in Fig. 18. The rf output frequency will change by the same amount as the original audio frequency; no changes to the SSB rig are required.

Now for the little-known field of pulse modulation.

As mentioned earlier, pulse modulation divides into four categories: PAM, PWM, PPM, and PCM. Let's look at them in order.

Pulse amplitude modulation bears a great

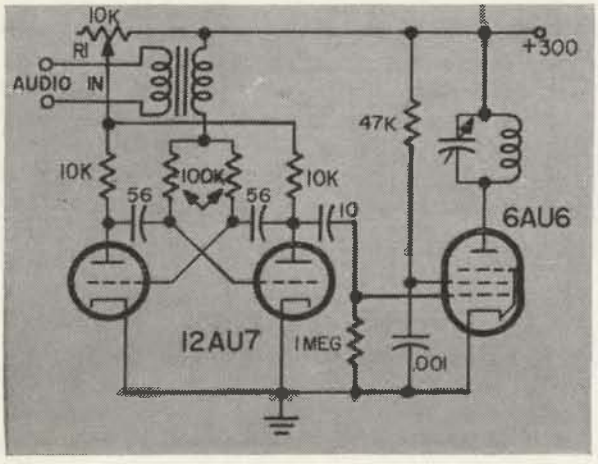


Fig. 18. Multivibrator FM modulator.

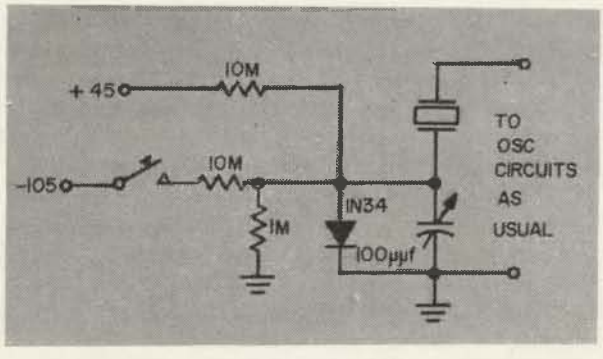


Fig. 19. FSK modulator.

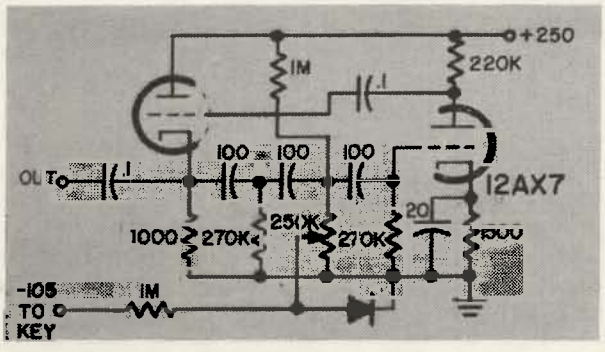


Fig. 20. FSK adapter for SSB exciter.

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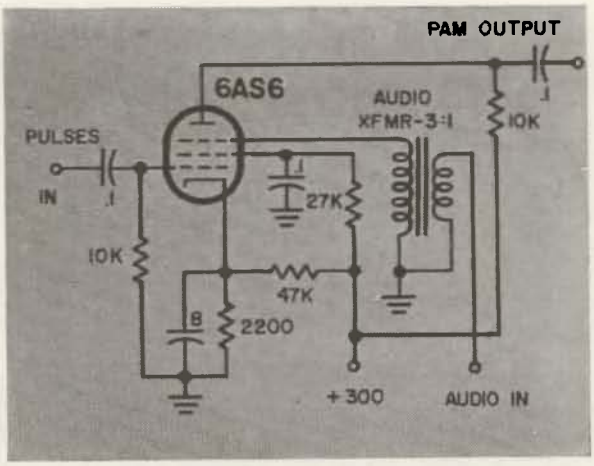


Fig. 21. Unidirectional PAM modulator.

similarity to conventional AM modulation. The pulse width and spacing remain unchanged, and the pulse height is varied to convey information. The transmitted pulses can be all positive-going, all negative-going, or can go in both directions. This gives rise to the subclasses called *unidirectional* and *bidirectional* PAM.

A circuit for a unidirectional PAM modulator is shown in Fig. 21. Here's how it works: The tube is essentially an amplifier whose gain is controlled by the voltage applied to grid No. 3; this voltage is the audio modulating signal. When the modulating signal is at its positive peak, the amplifier's gain will be greatest. Pulses from a separate pulse generator (which we'll examine later) are applied to grid No. 1. The amplified pulses appear at the plate and are coupled to the output. Since the modulating signal determines the amplification of the tube, the height of the output pulse will be determined by the instantaneous level of the modulating signal—and presto, PAM.

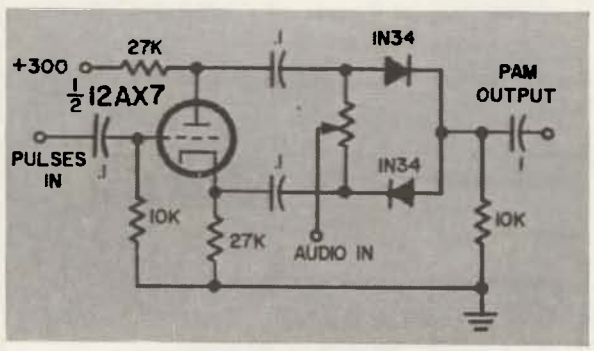


Fig. 22. Bidirectional PAM modulator.

The bidirectional PAM modulator of Fig. 22 is rather different; instead of being a variant amplifier, it's a stray balanced modulator. The diodes act as switches, which are turned on and off by the incoming pulses (the tube acts merely as a phase splitter to develop antiphased pulse channels). When a diode is "on", the audio voltage can appear across the output resistor. Polarity of the output pulse is determined by the polarity of the audio voltage.

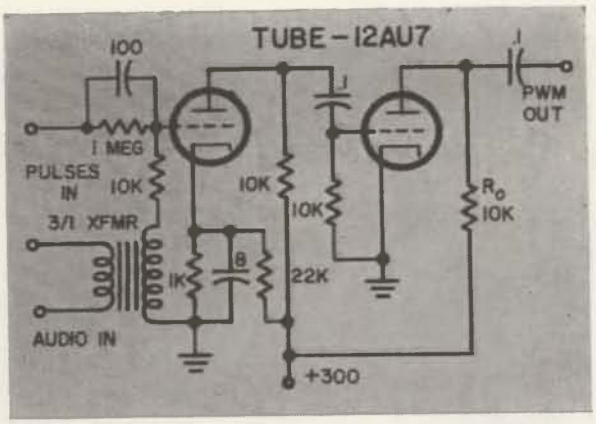


Fig. 23. PWM modulator circuit.

While the circuits are among the simplest of all pulse-type arrangements, PAM has more disadvantages than advantages in ham use. The only real advantage of PAM is that it allows high peak transmitter power; many of the noise-reducing tricks usable with other pulse circuitry are inapplicable to PAM, since the pulse height carries the information and cannot be disturbed. Unidirectional PAM can be received by conventional AM receivers; bidirectional PAM requires special receiver techniques, similar to its distant cousin, DSB.

Almost as simple to generate is pulse-width modulation, which offers all the advantages of PAM (including simplicity of reception) while picking up a noise-reducing benefit as well.

To generate PWM, we make a sawtooth out of our basic pulse from the master generator, then add this sawtooth to the audio signal. The combined signal is then fed to a slicer circuit which will not trigger on the audio signal component alone; the slicer triggers only when hit by the sawtooth riding the top of the audio. The sawtooth differs in width all the way up; since it's riding on top of the audio, the width of the sawtooth at the slicing level is determined directly by the instantaneous value of the audio, thus varying the width of the output pulse in proportion to the audio signal.

A circuit which achieves this is that of Fig. 23. Incoming sawtooth pulses from the master generator are added to the audio in the grid circuit of the left-hand stage; the plate-cathode circuit of this stage is biased to clip at such a level that only the peaks of the combined signal (the width-modulated sawteeth, in other words) get through. The second tube clips the tops off these sawteeth by saturation, leaving width-modulated pulses at the output. Other circuits are to be found in the references, but none are this simple.

Pulse-position modulation is a close relative of PWM; it is generated in much the

same manner but requires special circuitry in the receiver. To build a PPM modulator, simply substitute a 2.5 mh rf choke for the 10K resistor marked Ro in Fig. 23. This inductance will differentiate the output pulse into two spike pulses, one marking the leading edge and the other the trailing edge of the original width-modulated pulse.

For the past several paragraphs, we've been talking blithely about a "pulse generator" as if it were something which existed in every ham's junkbox. Actually, almost any circuit can be made to act as a pulse generator and the pulse references are filled with good, practical circuits. The requirements are that the pulse output be a symmetrical (one polarity of pulse narrow, the other wide), that the pulse repetition rate (frequency of the pulses, counting each pair of one positive-going and one negative-going pulse as a cycle) be greater than 8 kc, and that the output pulse shape be approximately rectangular.

The circuit of Fig. 24 is a cathode-coupled multivibrator, whose pulse repetition rate is adjustable from about 8 kc up. As shown, the circuit is free-running and can also be used as a square-wave generator for amplifier testing by proper adjustment of the "duty cycle" pot. In use, the output of this circuit is connected directly to the input of the pulse modulator, omitting any duplicated coupling capacitors.

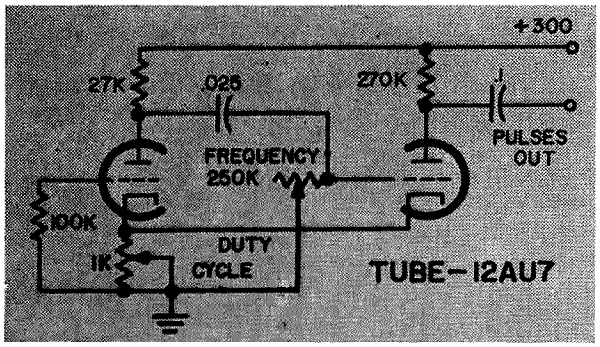


Fig. 24. Universal pulse generator.

In talking about PWM a bit earlier, we mentioned a noise-reducing benefit. With pulse modulation systems which do not depend on pulse height to carry information, noise can be almost completely eliminated by "regenerating" the pulses in the receiver before detection.

This "regeneration" has nothing to do with the more common use of the word as a synonym for feedback. "Regeneration" of pulses is more akin to the biological meaning of the word—replacing a damaged organ with new tissue, as a lizard's tail. To regenerate a pulse, you apply the incoming noise-contaminated pulse to a trigger circuit which is set to fire only at the peak of the pulse. Noise bursts will not be great enough to trigger the circuit if the pulse *peak* (not average level)

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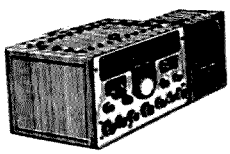
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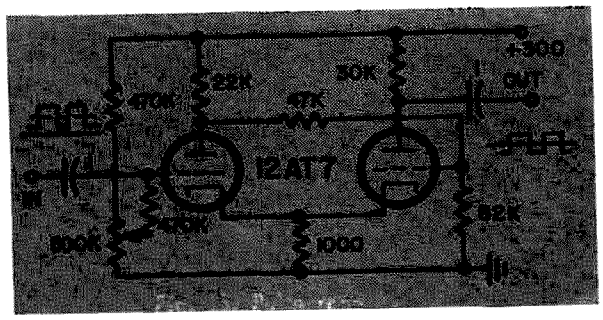


Fig. 25. Pulse regenerator.

is as much as 3 db above the noise level. The trigger circuit's output is a new pulse, minus all noise. Fig. 25 shows one such regenerator (a Schmitt trigger) together with input and output waveform sketches illustrating its action. The 500K pot is set for accurate duplication of the input pulse at the output, and usually requires an oscilloscope for adjustment. However, it need be touched only when the tube is replaced.

PCM, we're omitting. This comes about because PCM requires highly elaborate circuits at both the transmitter and receiver, and at the present state of the art appears impractical for general ham use.

We're almost finished now, except for the transmitter pulser. This is the circuit which takes the output of the various pulse modulators we examined earlier, and uses it to control the megawatts of rf output power from the transmitter. Essentially, the pulser is an electronic switch which turns the final on and off in accordance with the incoming pulses.

A circuit, taken from radar practice, is shown in Fig. 26. V1 is the switching tube, and C1 stores the energy. Normally, V1 is biased far past cutoff and in the absence of incoming pulses, no current can flow. The capacitor charges to 15,000 volts, but nothing else happens because no circuits are complete.

When incoming pulses of great enough amplitude to overcome the cutoff bias and drive the tube into saturation are applied to the grid of V1, though, things happen. V1 looks to the capacitor like a closed switch connecting the positively charged end of the

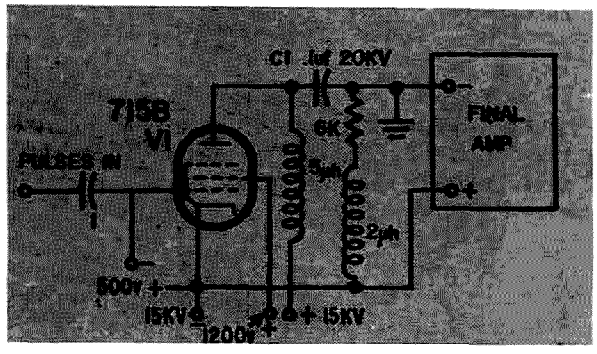


Fig. 26. Transmitter pulser. All supply voltages isolated from ground.

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capacitor to the positive terminal of the final; with power applied, the final produces rf output—great gobs of it (typical voltage and current in the circuit shown is 15,000 volts at 10 amps, which means 150 KW are going to the final. With normal PRF and duty cycle settings, the legally measured power to the final would be 150 watts!) This situation holds as long as the pulse is present at V1's grid, which is usually about a microsecond. Then everything rests for the next 99 microseconds, until the next pulse hits.

That's it—modulation from A to Z, with the more common garden-variety circuits omitted. If you're interested in more details, a number of specialized books are listed in the bibliography; these range from beginner to graduate-engineer level, and many give full design information for not only the circuits we've shown, but many others equally interesting for which we didn't have space. Happy modulation!

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NOTE: Before rushing to try out pulse modulation, check the latest issues of FCC regulations. Pulse modulation is permitted only in certain bands, all in the UHF region; it is taboo at conventional frequencies.

(W2NSD from page 45)

have been on the receiving end of unbelievable abuses as an invited speaker. I remember one small club which had invited both me and a local manufacturer to talk to them the same evening. They then proceeded to carry on a two and a half hour business meeting, a half hour for coffee, and then at 11 pm turned the meeting over to us with everyone yawning and looking at the door.

Many clubs seem at a loss for speakers. By the time you have exhausted all manufacturers of ham parts and equipment within commuting distance and had talks on special interests of your own members you will find that the manufacturers have come out with newer products that they want to show you. Unless your club is made up of particularly dead members you should have one or two live wires who are busy in their shack building something of interest. You can easily talk these chaps into bringing down their latest marvel and showing it off, complete with a short discussion.

There are many other activities which help knit a club together. Field Day is a great time for mutual effort and strengthens a club. Group construction projects are a lot of fun, particularly if you knock together a small two meter transceiver or convert a bunch of Link mobile gear to 6M for a club FM network. I wonder if any clubs have taken to mass manufacturing of KW linears yet? Mobile clinics on Saturday or Sunday morning are fine, with everyone bringing test equipment and helping each other to get their rig working. Hamfests, picnics, auctions, etc., are all good club strengtheners.

I suspect that this will result in a lot of much better ideas than I have proposed. Let's look for some good letters on the subject.

Arithmetic

A letter from Ray Frank W6JO, one of our Sharp Eyed Readers, asks, "Care to explain your arithmetic method in an editorial? Your SWORN statement in December 1961 says 15,166. In January 1962 you claim 40,000. Amazing increase." Ray goes on to compare our arithmetic to that of another ham publication. Ray, shame on you. You are hereby reduced from rank of Sharp Eyed Reader to Not Very Sharp Eyed Reader. If you read anything except the figure of 15,166 you will see that this is our *average* number of *subscriptions* over the preceding *twelve* month period.

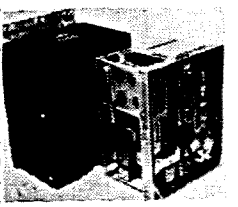
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(Turn to page 91)

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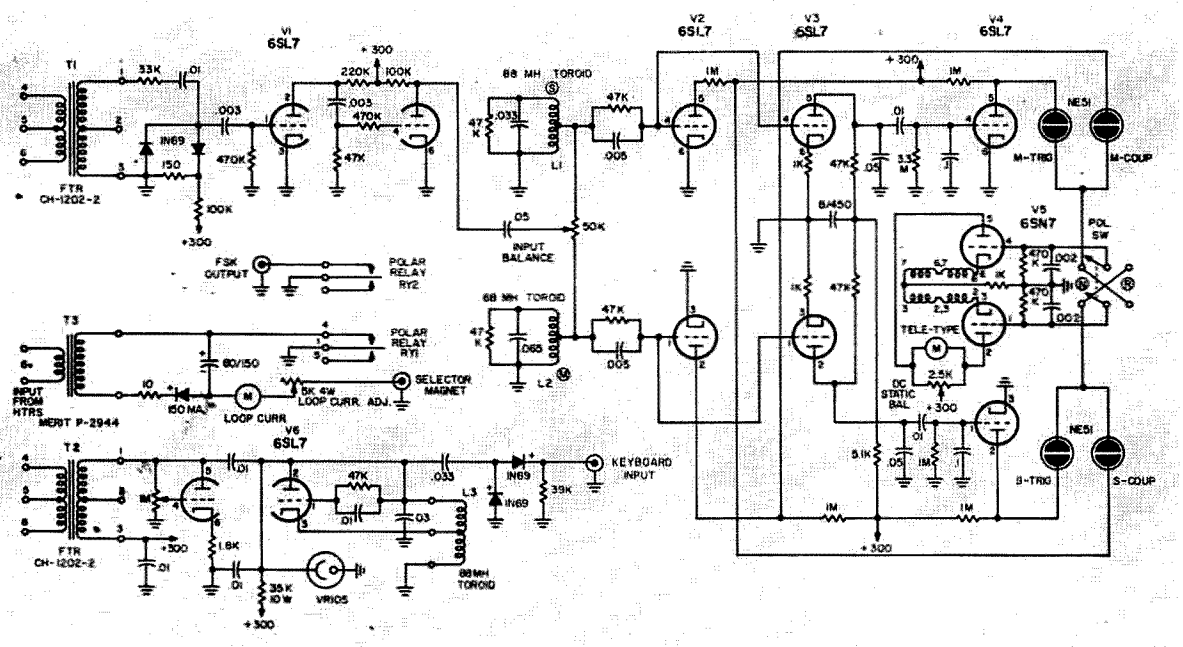
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(W2NSD from page 89)

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I. R. E.

Hundreds of hams will be in town for the yearly IRE Show on March 26-29. I'll probably run into many of you up at the show, or if not there then I'll see you at the Single Sideband Dinner-Hamfest at the Statler-Hilton on Tuesday March 27th. The displays open at 10 am, dinner at 7:30 pm. Bill W2SKE Leonard will master the ceremonies. Virginia will be there too selling subscriptions, back issues, bound volumes, TV Handbooks, and all sorts of things like that. Say hello.

The RTTY gang will gather on Monday night at the White Turkey Town House at 260 Madison Avenue in New York. 7 pm. Send $6 to Elston Swanson W2PEE, 101 New South Road, Hicksville, L.I., N.Y. Speakers will be W2JAV, W1BDI, W2DHE, etc. I'll be there too.

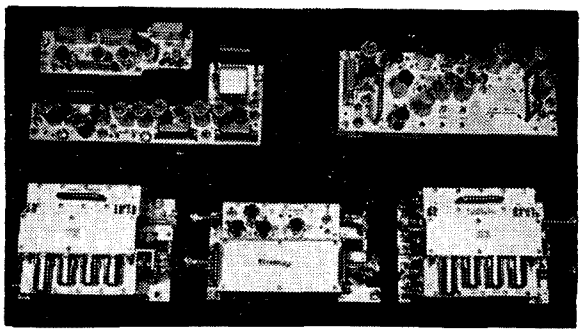
Let me know when you have something special coming up . . . hamfest, annual dinner, big picnic, etc. Let me know, that is, if a small bundle of the latest issue of 73 would help out as an added little something to give away. You'll have to give me some warning though for I am frequently so embroiled in staving off imminent disaster that it takes a few weeks before I can tend to details. You make it at least one months notice and I'll manage. You might mention whether you are expecting over 100 licensed amateurs (come on now, none of that "and their families").

March Last Year

We have a few copies of this issue available for those of you that missed it the first time around. 50¢ each. There were twenty-three feature articles in this issue, many of them of considerable lasting interest.

The lead article, undoubtedly the most hilarious we have ever run, explained how to translate technical journals. This is one you'll keep by the rig and read over the air at every opportunity. Next, in the construction department, was the W3KET transistorized GDO which you can build in minutes. W8UCG gave us detailed step-by-step instructions for elimi-

(Turn to page 92)



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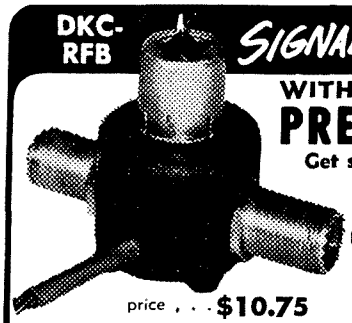
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nating ignition interference. The Sprague Company has since reprinted this extensively.

The old superregenerative receiver was then dusted off and brought up to date with a set of rules on taming the beast. Need a parabola for 1296 mc? We show you how to generate one. Associate Editor Kyle gives some hints on getting bugs out of gear in the shortest possible time. W2IHW shows you how to wind your own top loaded whip . . . and tune it. We also give you some ideas on various free supplies of plugs for interconnections.

All RTTY'ers will want to have the article on using their TT tape gear for sending CW. It is simple to do and I notice that even some CW men are starting to use the system.

K5JKX gives us the dimensions for the first article on a practical log-periodic antenna. This one is simple to construct and works fine on all bands from 160M to 10M. W4API shows how you can double your power supply voltage by throwing in some silicon rectifiers in your present supply. W4WKM gives us a list of the impedances of all popular surplus transmitters and receivers. Handy chart. K2DHA has a good idea on making that phone patch easy to connect and disconnect without bugging Ma Bell.

Another 73 first is the W3HIX all transistorized 432 mc converter. Part I this month, part II in April. We then have a little conversion of the six meter rig in our Oct. '60 issue putting it on 2M. K5JKX shows us how to build a four transistor amplifier right into a small speaker box to give us a complete speaker and amplifier all in one unit.

One of the most interesting staff articles on receivers was in the March issue. This one discussed front ends and pointed up the pro's and con's of all popular circuits, following this with a simple and important change to improve your receiver's front end.

There is a lot of good DX on 80 meter phone if you just know where to listen for it. W1FRR gives away all the trade secrets of this obscure sect. We have a transistorized meter amplifier for measuring very small voltages or currents. A test set for tuning the converted Motorola units. One of the top voted articles for March was the "Save, Learn, Have Fun—Build" by W8VVD. If you want to know about the reasons why fellows are building their own equipment, this will explain very well.

There are a few other articles of interest to: W7OE tells how 'sines' got started; OH2YV suggests a card index log book; W2IHW has a cute little transistorized noise clipper; W7CSD shows how to build a tuning meter for the blind ops; W6NKE complains about fellows buying bugs and then using them on the air before they learn how.

All in all it was a remarkable issue. There are a few left at 50¢.

Something New

In the process of leaning on prospective advertisers each month I run into some hints of things about to be marketed. Maybe you're interested? For instance there is the new remote switching mobile antenna by Mark which will cover all bands from 10 thru 80 and can be switched from the drivers seat. The last antenna I remember like this was the Rafred which used a little motor to run a switch up and down the antenna loading coil and tap in for the different bands. I used one of those with success for a couple years back when I had a Ford station wagon. It was a bit outsized for my Porsche so was laid to rest. The Mark unit, which will be similar to their HW-3, uses the Heli-whip units instead of the older fashioned loading coil.

Mini-Products will shortly be out with a shorty 40M beam, using their clever type of end loading. I understand that this job will be about the size of a ten meter antenna and will also work out well on 20-15-10! Maybe I heard wrong, that's a lot to get out of one little beam.

VHF-UHF has a new universal coupler in the works which will work with either 52 or 75 ohm coax. This will have a built-in field strength meter connection and a modulation monitor.

Tapetone (Telco) is trying hard to keep up with the orders on their 201 Nuvistor converter. They sent one down here for me to see. I farmed it out to WA2INM to test. Larry, who has built any number of 417A converters and Nuvistor converters and pre-amps, flipped over the 201 and bought it with the proceeds from his article on the test. We'll probably have this article for you by next month.

New Catalog

Cushcraft has just released their 1962 VHF-UHF antenna catalog. Nice. Beams for 420—220 mc, 2M, 6M, 10M, 15M, & 20M. Halos. Other stuff. You send for this catalog right now. Cushcraft, 621 Hayward Street, Manchester, N. H.

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has a cutie. The Nikey is designed to work with all types of electronic keyers. This is something quite different than you might think at first casual glance. It has two separate levers, one for dashes and the other for dots, each moving independently. Wait'll you get a feel of this one! Write Lefor Industries, New Caanan, Conn. $16.95.

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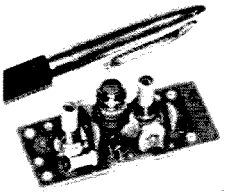
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FROM QST — JANUARY 1961

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73 Magazine

April 1962 • Vol. V, No. I

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Polytronics has really done it: six and two in one li'l package.

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"You're 80 over nine here, OM."

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Kilowatt transistorized modulator. Let us know if it works.

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. . . de W2NSD

. . . never say die

Columns

We have, so far, been able to keep successfully away from running any regular monthly columns. The thinking behind this, as you probably know, is that while most columns start out to be very interesting, after a while the authors run out of ideas and things get pretty dull. Of course there are several general types of columns that are presently available elsewhere . . . there is the operating news type thing where you can look up and see what has happened in your own special interest of late. One drawback of this type of reporting is the two months delay in getting the news in print that is part and parcel of publishing a monthly magazine. By the time you read about a DXpedition it is all over, etc.

A second type is the "listing of calls" style of column which attempts to get as many calls in print as possible on the premise that people like to see themselves in print. Unfortunately this makes terribly dull reading for everyone else. A third (very rare) type of column is that devoted to technical matters. Something like this would be printed in 73, were it to be submitted as individual articles.

Then along comes something like this Ham-TV, which has quite a need for a lot of communication between the interested parties. A monthly column would be a big help for the fellows getting on TV. But, again, it would be pretty dull stuff for all the other readers. The obvious answer to this is a monthly bulletin. Something like this can be printed inexpensively and fast, getting the information out in a matter of days instead of months. We could provide an eight page monthly (six to twelve a year) bulletin to all subscribers to 73 who pay one extra dollar per year. Since we are so well set up for producing things like that I think we could split the dollar with whoever was editing the bulletin, giving him a little incentive. While this wouldn't amount to much over $500 to $1000 a year, it still isn't a bad deal for a part time project.

We are all set for the Ham-TV bulletin, I believe. Mel Shadbolt, the author of our Ham-TV Manual, has been so swamped with requests for information on who is getting on where and with what that he has offered to take on the job of turning out a bi-monthly bulletin for the TV-ites.

This still leaves several other special interests that could well use some better communications. The moonbouncers and other UHF'ers sure do need some coordinating. I haven't seen anything national in the way of a traffic bulletin, but then maybe there aren't enough fellows interested in having one. There used to be a fine RTTY bulletin, but I haven't seen one of those for over a year now, which leaves another field wide open. The DX Bulletin by Don Chesser is doing a fine job, but perhaps there is a need for a lower cost monthly bulletin in this field. You can probably think up a lot more that would serve a useful purpose.

If you are seriously interested in editing a monthly bulletin for some special interest and you have the experience to know what you are talking about in that field, then maybe we can get together. We can shoulder the entire cost of printing and mailing the bulletins if you can provide us with the manuscript all set to be printed each month on a fixed immutable schedule. We can advertise the bulletin in 73 and charge one dollar per year for it, sending you one half of the receipts as your payment. Sure, we'll lose money on the deal, but it'll be a valuable service and it will be worth it. If all this sounds reasonable and you want to sign over your soul to the publishing field, then drop a line.

Navassa Island

Back in 1958 a group of us got together and had a little DXpedition to Navassa Island, using the call KC4AF. This was probably one of the most successful DXpeditions in history,

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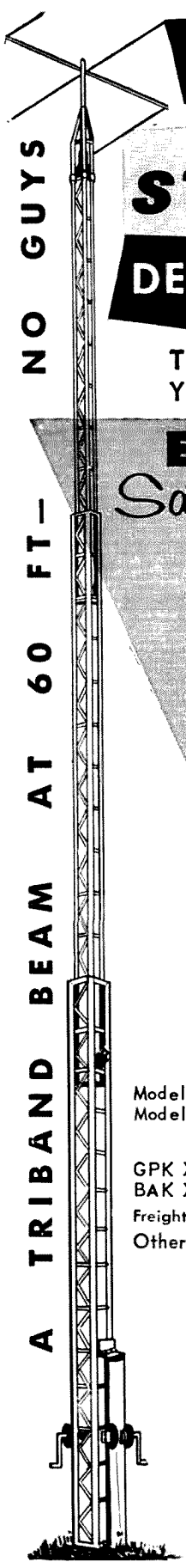
April 1—Advantages of compactron multi-function tubes in electronic equipment.

April 8—What computers can do.

April 15—Latest trends in military type transistors.

April 22—Transistorized citizens band transceivers.

April 29—Use of transistors as high power amplifiers and oscillators.



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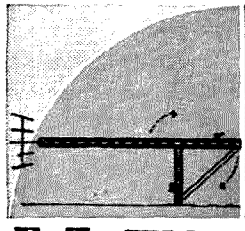
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with over 7000 contacts made in just four days of operating. The six of us that went on the trip had quite an experience. The trip was exceedingly difficult and very expensive by our standards. The main things left over from the trip at this late date are fond memories of the hardships and fun and the pictures we took at the time.

When I left CQ Magazine back in January 1960 my entire collection of slides of the Navassa trip were on loan to a radio club, along with a tape recorded commentary. These were returned to CQ later and I have so far been unable to get them back. I would like to be able to again enjoy the slides of this trip and perhaps be able to show them at occasional ham clubs and conventions. They are good and they are interesting. Perhaps if you would help me in this matter we could influence the Publisher: S. R. Cowan, the Acting Publisher: Richard Cowan, or the Production Manager: Cary Cowan, that it would be the fair thing to return these slides. If you just drop any of them a QSL card with a note at 300 West 43rd Street, New York 36, we might get some action.

How To Help

Many subscribers have written in to ask what they can do to help boost 73. There are two necessary ingredients to the success of 73: readers and advertisers. Anything you can do to help with either of these departments will be greatly appreciated and will result in a bigger and even better magazine. There sure is a lot yet to be done in both of these directions.

In the readership end of things there are few fellows who have not by now at least heard about 73. There are still a lot that are not subscribing. This can be attended to at your club meetings (we have special subscription rates for five or more received at once: 50¢ off on each subscription) where the subject can be broached regularly until resistance wears down and the pinch-penny members part with their worn faded dollar bills. Many articles in 73 make fine discussion on the air and who knows, you might convert someone from Brand X. With a little persistence you can easily brainwash several unsuspecting fellows a day.

You might keep a sharp eye on the advertisers and encourage new companies with re-

(Turn to page 86)

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Photos by Ben Head K5HWF

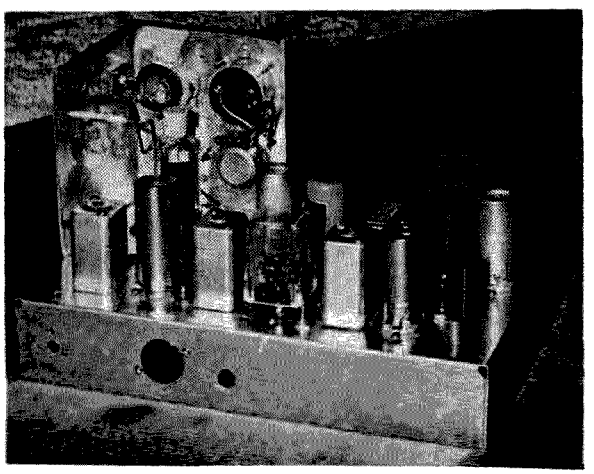
HAVE you been thinking of getting on sideband on six, but financially it almost seemed impossible. Now is your chance—especially the Technician who probably does not own a HF sideband exciter—to go with a transverter. Quite an investment is involved in our modern exciters available on the amateur market.

The author feels that the exciter presented here is the minimum he could construct as for cost, but the effort is a little bit more. During the design and construction stages, several of the circuits have been modified or remodified at least a dozen times. It is about the most simplest that could be built and still give good quality sideband, either upper or lower.

Most builders have quite an assortment of junk—resistors, capacitors, tubes, transformers, etc.—and from this assortment plus the bargain basement electronic parts this exciter can be fabricated. The most expensive item in the exciter is the B&W type 2Q4 model number 350 plug in phase shift net. The other larger items are the 2E26 or a 6146 if you desire it, 1:3 step up transformer, and two universal audio output transformers rated at 4 watts each.

Since the 6 meter band is dead in this part of the country only local checks could be made. The exciter was complimented in every case. Its output is approximately 5 watts PEP using a 300 volt 200 ma. power supply.

In this article a suggested lay-out is presented. The author used it with success, but it is not what could be called beautiful. This was strictly an experimental model.

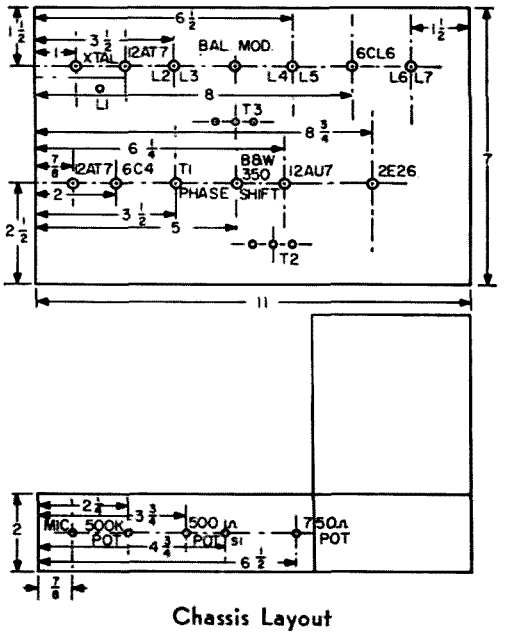


No hetrodyning is done in this exciter. It is strictly a straight thru type. Starting with an 8 mc. rock, using the third overtone and doubling it into the balanced modulators. (Refer to block diagram.) The balanced modulator was constructed in a plug in the eight pin octal accessory case. Refer to sketch for pins that the 1N34's are soldered to. This method was used because of the natural shielding and that various types of diodes could be tried without disturbing the other wiring. The bargain 10 for $1.00 diodes were tried and they worked fine.

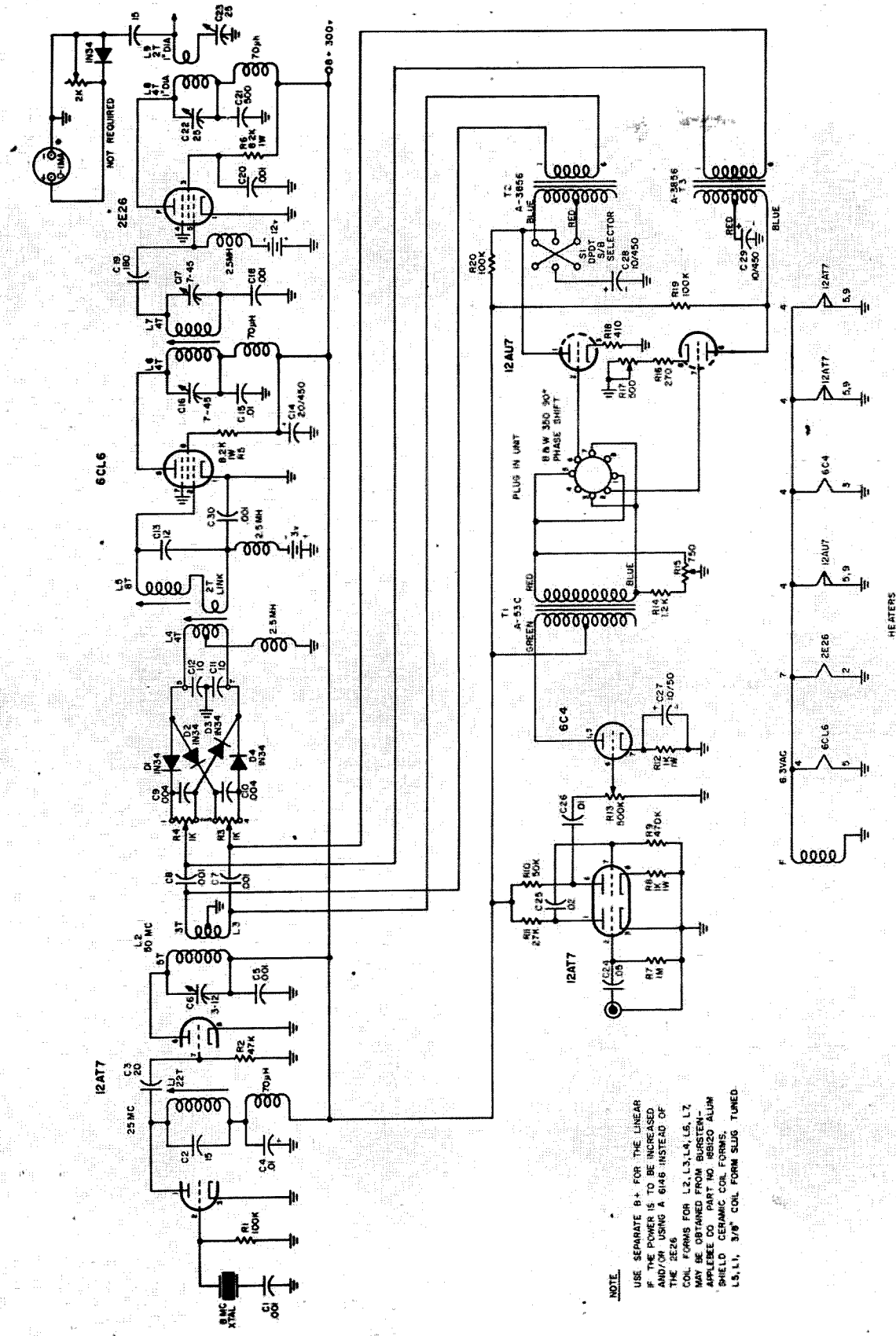
Three slug-tuned ceramic coil forms with aluminum shields were used for L_2L_3, L_5 and loop, and L_6L_7. L_4 is a standard ⅜ coil form tuned to the desired frequency. The ceramic coil forms can be obtained from Burstein-Applebee, part number 18B120 for less than a half dollar each. They can be dismantled for rewinding your own coils. The coil forms are ½ inch in diameter.

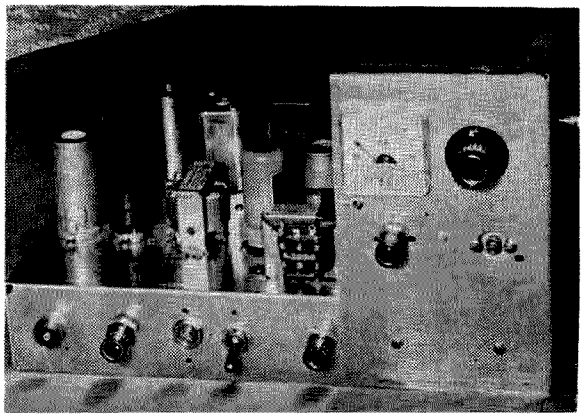
Let's get with the building of the exciter. Each section of the exciter will be described separately except for the chassis. Refer to the lay-out drawing and photographs for location of components. Cut all holes in the chassis and install all sockets.

For L_1 a ⅜ inch ceramic slug tuned coil form coil was used. Wrap 22 turns of #24 beldenamel wire closely wound over the form.



Chassis Layout


NOTE
USE SEPARATE B+ FOR THE LINEAR IF THE POWER IS TO BE INCREASED AND/OR USING A 6146 INSTEAD OF THE 2E26
COIL FORMS FOR L2, L3, L4, L5, L7 MAY BE OBTAINED FROM BURSTEN-APPLEBEE CO PART NO 48120 ALUM SHIELD CERAMIC COIL FORMS.
L5, L1, 3/8" COIL FORM SLUG TUNED
HEATERS
PLUG IN UNIT
B+ 300+
NOT REQUIRED
2E26
6CL6
12AT7
12AU7
6C4
12AT7
12AT7
12AT7
12AU7
6C4
2E26
6CL6
6.3VAC
8 MC XTAL
25 MC
50 MC
S1 DPDT S/B SELECTOR
B.A.W. 350 90° PHASE SHIFT
T1 A-93C
T2 A-3856
T3 A-3856



Shunt L_1 with C_2 a 15 mmfd capacitor. This should cover between 25 and 25.5 mc. Follow schematic and wire the oscillator. Apply 300 volts thru a 70 uh choke to the bottom of L_1 and check the oscillator output.

The doubler should come next. If a shielded ceramic coil form has been obtained as described above, disassemble and remove all capacitors and windings. Rewind five turns of #20 beldenamel wire in a location where the slug can be all the way in or out of the winds. This will be your fine tuning. Wind three turns of #24 over the five turns and center tap this which will go to ground. Assemble the doubler and apply voltage 300 volts. Locate the three turns up or down over the five turns until the output is near equal at both ends of L_3. Check the output with a vacuum tube volt meter. This completes the oscillator sections.

Balanced Modulators

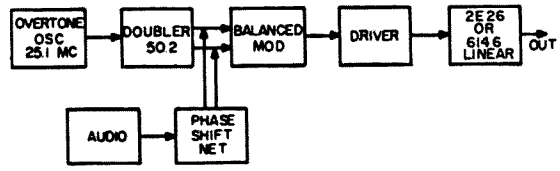
Install 1K, R_3 and R_4 pots near the balanced modulator socket. Fabricate the modulators in the Lafayette RY-262 equipment case as indicated in the figure. The modulators may also be made permanent in the exciter if desired. The author feels that the plug-in type of assembly is more desirable, because different diodes may be checked for best results. L_4 and the 2 turn link is on the same coil form. Use the same type of coil form as the doubler and wind one turn on each side of center tap of L_4 for the link.

6CL6 Driver and 2E26 Linear

L_5 is a ⅜ slug tuned coil form wrapped with #24 beldenamel wire. L_6 and L_7 made up on the 18B120 slug tuned coil forms. L_7 is wrapped over L_6, using #20 wire for L_6 and #24 wire for L_7. Approximately 300 milliwatts is obtained from the driver, which is enough to drive a 2E26 or 6146. No neutralization was needed with the 2E26. The linear indicated may be used or your own design. L_8 and L_9 are constructed of #14 solid wire; enamel insulated wire was used for L_9. Mercury batteries were soldered in permanently in the circuit for bias on the driver and the linear.

Audio and Phase Shift Net

Wire as indicated on the schematic and no problems should be encountered. S_1 DPDT selects the sideband desired. The plug in B&W phase shift net is a jewel and really does the job.

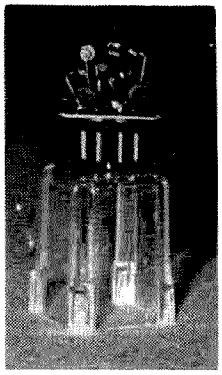


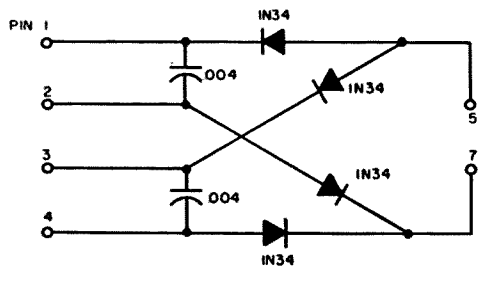
Block Diagram

Power Supply

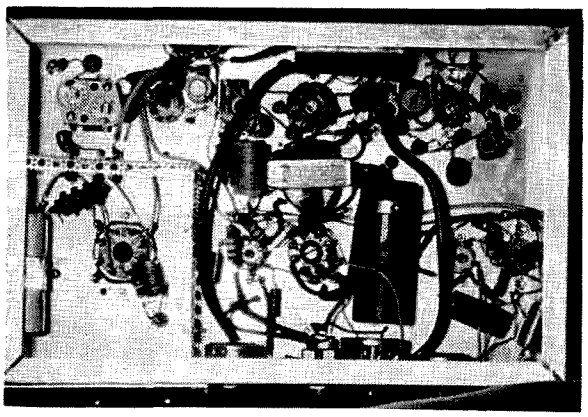
The only requirement for a power supply is that it delivers 300 v B plus at approximately 180 ma. and of course 6.3 v ac for the filament. The author did not use a regulated power supply, but it can be expected that the exciter would perform better with one. If a higher B plus is used it is recommended that a separate plate supply be used and a 300 v regulated supply. Refer to the Radio Amateur's handbook for plate, screen and bias voltages when using higher B plus on the linear.

After completing the construction check all wiring, making sure that no mistakes were made. If everything checks good you are ready to fire her up. Use an rf probe with your vacuum tube volt meter in connection with a dummy load to tune and peak up the exciter. To inject a carrier unbalance the modulators and a low level will be obtained. This is enough for peaking. With the power applied adjust R_{17}





Balanced Modulator

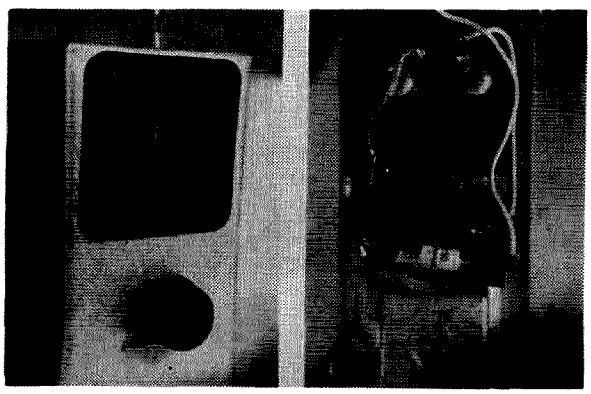


until both plates of the 12AU7 are approximately 175 volts. When the modulators are balanced, the carrier should drop almost to zero. Using an audio oscillator or a mic, adjust R_{13} and R_{15} for quality; you may check this on your receiver. Watch the meter swing up when modulating. To get a real check of the exciter put an SWR meter in your antenna line and check with your buddies for best settings of R_{13} and $_{15}$. Good luck during next summer's Sporadic E season. Give me a call. ... K8NIC

Field Strength Meter for 6 and 10

Allan Schechner W3YZC

A field strength meter doesn't have to have transistors or tunnel diodes to be sensitive. Just observing a few basic principles such as tuning and matching helps. Most hams are familiar with the timeworn field strength meter circuit using an rf choke, diode and a milliameter; in fact it is probably the most commonly used type. With this arangement, however, there is a large mismatch between the low impedance meter and the whip antenna. Not only that, the meter will respond to spurious frequencies. This meter incorporates an antenna "loading coil," which in one fell swoop tunes and matches the circuit, and effectively lengthens the antenna. The secret is that the coil is constructed by "cut and try" so that it matches the builder's particular circuit.



Using a surplus 500 microamp meter commonly available for $1.75, the circuit is wired as in Fig. 1. This wiring is not critical as to layout; winding the coil is.

Cement a seven inch length of #12 tinned wire into the body of a banana jack by first forming a loop in the wire to obtain a pressure fit. Drill a 1/64 inch hole as in Fig. 2 and fish the end of a five foot length of #24 enamel wire into it. Solder the end of the wire to the metal part of the jack and screw this part into the plastic, while twisting the wire in the hole to take out the kinks.

Start the winding with 45 turns, which should take you to the end of the plug and tap solder the wire to the antenna. Loosely couple a grid-dipper to the coil and check frequency. Remove two turns at a time until you hit 29 mc. First check the grid-dipper with a communications receiver to be sure you know where 29 mc is with some degree of accuracy.

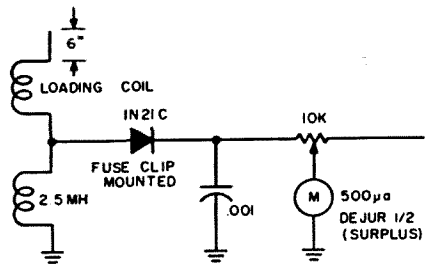


FIG. 1

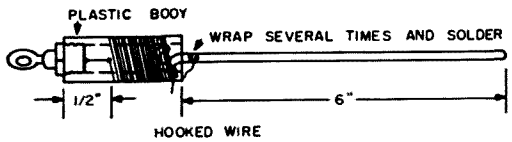


FIG 2

During the coil pruning operation, the grid-dipper should be far enough from the F.S.M. so that only a slight indication is noted on the microammeter. This prevents detuning of the loading coil. When the coil is completed, permanently solder the end of the winding to the antenna, covering the whole assembly lavishly with coil dope.

After completing the electrical portion the author found that an Ajax magnetic door latch could be fastened into the bottom of the case. This allows the tiny meter to be firmly attached to metal surfaces such as the roof, trunk or dashboard of a car. Cut a 5/16 inch by 1⅛ inch slot as indicated for the magnet to protrude through the bottom and cover this with a thin piece of tape to protect it from scratching.

By removing more turns the unit will operate on six meters. Using the banana jack makes it convenient to construct a set of antennas. Start with thirty five turns for the six meter winding. When in use, you will almost certainly find a need to use gain control R_1 to reduce sentitivity. ... W3YZC

Forty Meter ZL Special

Doug Gaines W4AXE
2323 S. E. 11th Street
Gainesville, Florida

AFTER struggling through the morass of commercial broadcast stations around 7135 kc to copy the Florida RTTY Emergency Net one Sunday afternoon, I staggered out of the shack swearing never again. Unless you've had the experience of being kicked in the head by several foreign soap operas crying to the tune of 50 kilowatts or so each, it's hard to imagine the exasperation involved in trying to work RTTY on forty from this location. As I had the coverage of Florida primarily in mind, and the working of stations on the Eastern Seaboard as a second consideration, I decided that a fixed antenna with good forward gain and high front to side ratio would fill the bill.

The ZL special has been around for a good number of years but has been used mostly on ten, fifteen, and twenty meters. After reading the specifications, this seemed to be a good prospect for my beam.

The antenna described here is a variation of the ZL special and is a good compromise of good gain and directivity, small space requirements, and best of all, low construction cost. The total list of supplies consist of two 2x2's, 300 feet of wire, a hank of TV twinlead, and twelve insulators which can be cut out of plexiglass. Before we begin the description, let me say again that this was not built for a DX antenna, but rather for good coverage of Florida, of which 80 percent lies south of this location. However, when it was temporarily raised to sixty feet, the first contact was in South America.

Basically, the antenna is a pair of folded dipoles fed 135° out of phase. The ends of the elements are drooped downward to form a pair of inverted V's hung from a common boom. All wires on each side of the boom are in the same plane, resulting in the whole array looking something like a four element beam.

Construction begins with the boom which can be of either wood or tubing cut to 17 feet 6 inches. I used two 2x2's butt-jointed and reinforced at the center to reduce sagging. Insulators were fastened at each end and at 18 inches in from each end as shown in Fig. 1. The director consists of a folded dipole resonated at the desired frequency. The reflector is cut about 8 percent longer until the antenna is raised and tuned. Between the feedpoints of the two elements, a length of 300 ohm TV lead-in is connected with a half twist for the phase shift. This lead-in handles my kilowatt okay in this application. The feedline is connected at the feedpoint of the director. With the dimensions given for 7140 kc or using the formulas in Fig. 2 for other frequencies, the impedance is close to 75 ohms. I played around with 75 ohm twinlead and baluns for my transmitter. Needless to say, bandswitching became a dismal affair. In desperation, I tied on RG-11, and, wonder of wonders, it worked! The pi-network of my linear was quite happy with the new load.

The end wires of the director were adjusted in and out until a low point was found in the SWR at the desired frequency. When the best point was found, the wires were soldered in place. The reflector was tuned in the same way for maximum gain, using a field strength meter. This was done with the boom raised to its permanent height and the elements stretched out to their approximate tie points. At this location, the apex of each V is at 40 feet and the apex angle is 60 degrees. Sharper angles tend to decrease the usable bandwidth and directivity. As this angle is decreased, a point is reached where the array becomes too critical to tune. This point seems to be at an angle of 30°.

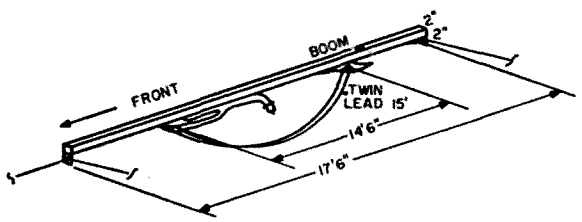
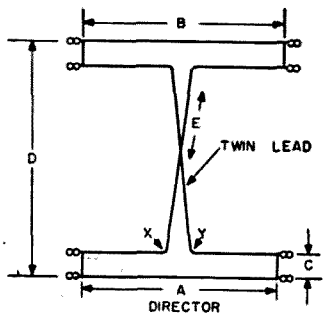


FIG. 1



GENERAL FORMULA	DIMENSIONS FOR 7140kc
A = 433 /mc	A = 62.1 ft.
B = 467/mc	B = 65.5 ft.
C = 11/mc	C = 1.5 ft.
D = 123/mc	D = 17.5 ft.
E = 111/mc - 300Ω TWIN LEAD	E = 15 ft.

FEED LINE CONNECTS AT X-Y

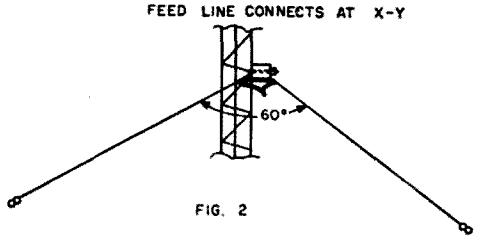
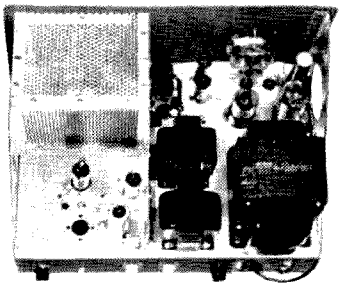
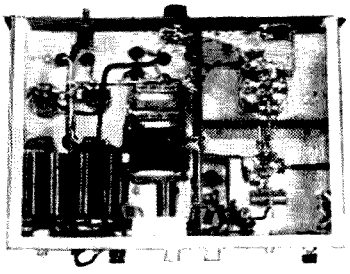


FIG. 2

175 WATTS SSB ON SIX METERS with P & H 6-150 TRANSMITTING CONVERTER





Here's the simple, easy way to go VHF on SIX METERS! Just feed the 20 meter output of your present SSB, AM or CW exciter into the P&H 6-150 and you have 175 Watts PEP on SIX METERS, either crystal or VFO controlled, depending on your exciter features. Resistive Pi-Pad and switchable Half-Power Pad permits operation with any 5 to 100 Watt exciter. Since the 6-150 is a high stability mixing device, the output signal stability is the same as that of your exciter. Uses a 6CX8 crystal oscillator/Class A buffer; a 6360 Balanced Mixer and a NEW AMPEREX 8117 push-pull output tube. Power input to 8117 final: 175 Watts PEP on SSB, 165 Watts CW, 90 Watts linear AM. Entire chassis and all shielding is COPPER PLATED. Output jack provided to furnish oscillator signal injection for receiving converter. Quiet 200 CFM forced-air cooling. 50-70 ohm input and output impedances. Husky built-in power supply has three separate rectifiers and filter combinations. Meter reads; PA GRID, PA PLATE and RELATIVE RF OUTPUT. Modernistic curved corner grey cabinet; 9" X 15" X 10½". The P&H 6-150 is so thoroughly shielded, by-passed and parasitic-free that it operates as smoothly as an 80 meter transmitter. COMING SOON! THE P&H 2-150 FOR TWO METERS!

Complete — With Built-in Power Supply, All Tubes and Crystal, for Only $299.95

WRITE FOR LITERATURE

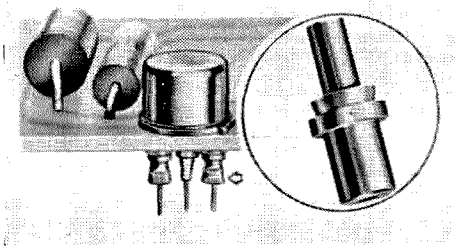
P & H ELECTRONICS INC.
424 Columbia , Lafayette , Ind.

This is a simple antenna to build if you have a structure such as a pole, tree, or tower that can support the boom at 30 feet or more. 40 feet seems to be a good height for working stations out as far as 400 miles. The labor is well worthwhile when the performance is considered.

I checked gain against my dipole, which is 20 feet higher than the beam. When transmitting, forward gain to stations 100 miles or closer is about 6 db better than the dipole. On longer hauls, it is closer to 10 db as reported on good receivers, such as 75A4's, HQ-180's, 75S-1's, etc. On receive, a real mystery pops up. When I switch from the dipole to the beam, signals from the South jump at least three S-units. This dipole is a good one, too. The high readings may be due to a greatly different radiation angle or to the presence of obstacles in the field of the antennas. I think that a more likely reason is the same thing that makes the cubical quad and dual-diversity beam such good receiving antennas. All have a large cross-section and each has nearly an equal proportion of vertical to horizontal components. Front to side ratio is about 25 db measured with a field strength meter. Front to back was purposely kept low, as I did not want to lose northern stations. Stations to the East and West are down far enough to make forty meters much more comfortable to work.

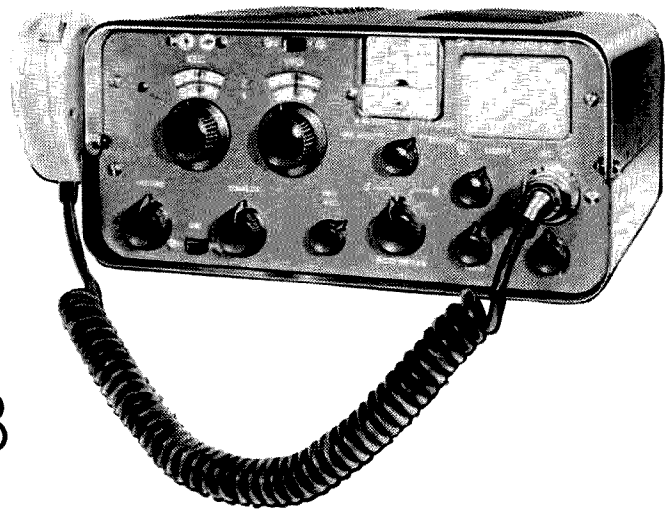
So, fellows, let's don't let forty fall by the wayside as a reliable band because of small space. This antenna can take up almost as little space as a full sized twenty meter beam and is still full sized on forty. Don't be persecuted by Russian propaganda stations or get involved in *John Loves Mary* in Spanish. Put up the Inverted-V ZL-Special and live! ...W4AXE

A Grabber



Soldering leads shortens transistors life. Heat sinks, often not infallible, necessitate undesirably long transistor leads. What do we do? We build transistors, beautiful little gems, expensive little gems. Then we blithely ruin them by the thousands trying to solder them into the circuit. The solution? Classically simple. Don't solder transistor leads. Insert and solder special crimpable eyelets in the circuit. Then slip the transistor leads thru these and crimp, giving a positive electrical connection and the shortest one possible. I know. *I* should have thought of it, too. *Vector* has them all ready to go. They're called TRANSCRIMPS, available from Vector Electronics, 1100 Flower St., Glendale 1, Calif.

73 Tests the Poly-Comm 62B 6 & 2 Meter Transceiver



Roy E. Pafenberg W4WKM

A strong newcomer in the VHF equipment field is the Poly-Comm Model 62B, 6 and 2 meter transceiver. This compact little unit is designed for mobile and home station use, containing a universal power supply for both modes of operation. Study of the specifications will show that the manufacturer, Polytronics Lab Inc., really took on a task in designing the unit.

This transceiver proved to be very difficult to evaluate. The time proven approach is to compare any new equipment with the competition in the areas of features provided, performance and cost. In this instance, the usual yardsticks do not exist. No competitive product provides 6 and 2 meter coverage, self contained universal power supply and self contained VFO for both bands.

The photo shows the external details of this attractive little package. A universal mobile mounting bracket, provided but not shown, allows the unit to be mounted in almost any mobile location. Before going into the results of the test, a brief circuit description is in order. Reference to the block diagram and the specifications will assist in understanding the following discussion.

The receiver section, designed for AM reception only, consists of a 12 tube superheterodyne circuit using triple conversion on 2 meters and double conversion on 6 meters. A high gain, cathode coupled, dual triode rf stage works into a Nuvistor first mixer. A 94 mc, crystal controlled Butler oscillator supplies the injection signal. On 6 meters, the oscillator is disabled and the signal idles through the first mixer. A voltage regulated, Colpitts oscillator, operating at 46.595 ±2 mc is used to supply injection to the second mixer. The oscillator and second grid mixer circuits are gang-tuned, resulting in a second *if* frequency of 5.405 mc. A stage of amplification follows, feeding the third mixer. Here, a 4.95 mc crystal oscillator is used to produce the final 455 kc *if* frequency. Two stages of 455 kc amplification are used to obtain the desired selectivity.

It will be seen that the rf-*if* portion of the receiver section is essentially a good design, double conversion 6 meter receiver with a high performance, crystal controlled converter used to provide 2 meter coverage. The results are very good and actual tests show that the claims of image rejection and selectivity are actually exceeded in production. The price paid for this superior performance is the presence of the two spurious responses pointed out in the specifications.

Silicon diodes are used in the detector, AGC delay and ANL circuits to provide excellent, hum-free performance. A dual triode is used in the squelch and first audio stages which drive the parallel connected 6BQ5 audio output tubes. These tubes, which are also used as modulators in the transmit condition, drive an internal 2½" PM speaker. Rear-chassis terminals are provided for use of an external speaker if desired.

The 62B transmitter section is more or less conventional except for the inclusion of the internal two band VFO. A switch permits selection of the VFO or a front panel mounted crystal. The oscillator frequency is tripled in the plate circuit and feeds a frequency doubler, driving the 7551 output stage on 6 meters. An additional tripler stage is switched in to give 2 meter coverage. The modulator consists of a high gain pentode followed by a triode which drives the 6BQ5 modulator tubes. The ceramic microphone supplied with the transceiver is matched to the speech system for optimum re-

sponse. A side advantage is that the audio gain may be fixed and still provide good performance.

Antenna feed requirements for both the transmitter and receiver are a reasonably flat 51 ohm termination. SO-239 connectors are used for separate 6 and 2 meter antennas. In the event one of the increasingly popular two band antennas is used, an internal strap connection will permit using a single connector for both bands.

The internal power supply employs a special power transformer which allows operation from the ac line or, using a conventional vibrator circuit, operation from 12.6 volts dc. Circuit switching is accomplished by inserting the appropriate power cord in the chassis connector. Four silicon diodes in a voltage doubler configuration supply the high voltage requirements. Another silicon diode powers the dc relays when the transceiver is operated from the ac line.

The unit loaned for the test, Serial Number 12B719, was accompanied by a letter from Bud Hargreaves, W2SXB, Chief Engineer of Polytronics. The letter said, in part, ". . . We have found that evaluations of equipment have been stilted and have been directed toward the good points, etc. We hereby authorize you to mention any undesirable features which you may find in the unit. . . ." Bud went on to specifically mention a couple of problems in the equipment. Some problems exist in any product but they are normally kept a dark secret by the manufacturer. If an unwitting user points out one of these problem areas, the manufacturer all too often expresses shocked surprise that such a condition could exist. The frank and open attitude of Polytronics is indeed a refreshing change.

Bud's statement was taken at face value and the transceiver really put through its paces, both on the air and on the bench. A local amateur, who prefers not to be identified, had expressed an interest in looking over the 62B and I was quick to take advantage of his experience. His competence is based on many years of professional and amateur VHF equipment design experience and backed up by some rather extensive test facilities. After inspection and limited testing, the unit was hauled to the basement lab and given the works. The tests resulted in 8 pages of notes, too lengthy to reproduce here. Environmental testing equipment was not available so specifications relating to temperature, shock, humidity and vibration were not checked. I don't claim that full-fledged compliance testing was conducted but a wealth of equipment was available and the balance of the specifications were checked out to the extent required to detect any serious departure from the manufacturer's published claims.

The 62B appeared capable of meeting or exceeding all specifications except those on transmitter VFO stability. As noted in the specifications, frequency stability of the VFO is cited as being within ±.02% from —20° C to +60° C. This figures to be ±29.2 KC at 146 MC. Bench tests showed drift in excess of this. Tests were conducted at room temperature of 21.5° C, using thoroughly warmed up and calibrated equipment. The 62B was turned on after being off for 24 hours and the VFO "spot" switched on only long enough to accomplish the measurements conducted at 5 to 10 minute intervals. Results, from a starting frequency of 144.312 MC, were as follows:

VFO drifted down 106.0 kc in 1st 30 minutes
VFO drifted down 24.0 kc in 2nd 30 minutes
VFO drifted down 12.0 kc in 3rd 30 minutes
VFO drifted down 2.5 kc in 4th 30 minutes

At 5 hours and 36 minutes, the transmitter was operated key down for 10 minutes, resulting in an adidtional downward drift of 600 cycles. At the conclusion of this test, a thermometer placed loosely on the top of the cabinet read 53° C, a rise of 31.5° C over ambient.

Receiver stability measurements were conducted on 2 meters and performance was within specifications of ±.06%. This test was conducted by accurately measuring the second oscillator frequency. From a cold start, the unit drifted up 27 kc in 35 minutes and then drifted down 12 kc in 1 hour and 37 minutes. Drift on 6 and 2 meters is essentially the same.

Inclusion of the VFO feature in a 6 and 2 meter transceiver of compact construction poses many problems. Extreme supply voltage and temperature variations, vibration and shock are present in mobile operation. The oscillator tank switching problem is another obstacle that must be overcome. Polytronics has chosen the oscillator-frequency multiplier approach and the results serve to highlight the problem. The stability, while certainly not the best, is probably as good as can be expected in a competitively priced equipment of this type.

While the "state of the art" approach of a limited range, high frequency VFO and crystal controlled frequency converters could be used, a number of tuning ranges would be required for full coverage of both bands. Further, the increased circuit complexity required to reduce spurious output frequencies would probably price the equipment out of the market.

The balance of the test proceeded nicely. Receiver performance is all that is claimed. Selectivity was found to be even better than that cited in the specifications. 6 db bandwidth was measured at 3.9 kc and 40 db bandwidth at 19.5 kc. This degree of selectivity is very comforting to have, however it imposes more stringent stability requirements on the receiver circuitry and makes any drift in the received signal more pronounced. Retuning of the 62B is required during warm up. Sensitivity is excellent and overall performance such that weak signals really come up over the noise. S-meter readings were correlated with input level and each S-unit between S1 and S8 reflected an

average of 5.4 db increase in signal level. Image rejection is exceptionally good. The second and third *if* frequencies could not be detected on the 2 meter band, with the full 2 volt output of a General Radio 805-C signal generator pumped into the antenna connector. The two 2 meter spurious responses were present at the predicted intensity.

The receiver audio system is more than adequate and no trouble was encountered with microphonics when using the internal speaker. The shock mounting used for the receiver tuned circuit assembly and the transmitter VFO really shows its merit under conditions of vibration and shock. The squelch circuit works well and can be set to trip on signals way down in the noise. The squelch threshold is fully adjustable and the adjustment holds for extended periods.

Power output of the transmitter was measured, using a Bird Termaline Model 61 RF Wattmeter. Measured power output into this 50 ohm load of 9 watts on 54 mc and 5.5 watts on 148 mc agreed with the final inspection check list packed with the transceiver.

I was very much impressed by the quality of components used in the 62B. Teflon insulated wire is used throughout the unit and all metal parts are heavily plated. The quality of workmanship in the assembly and wiring is uniformly good. Careful attention to mechanical details, including the shock mounting of the receiver tuning elements and VFO, contribute to the overall performance. Physical layout of the front panel is good although the compact size of the unit does make some compromise necessary. The front panel mike connector is comparatively large and, as a consequence, the PA tuning and loading controls are a bit difficult to reach. Fortunately, these controls do not require constant attention so no hardship is imposed. The recessed front panel provides ideal protection for the controls in the mobile environment and this feature should not be sacrificed. However, when the unit is placed on the operating table, the meter and dials are somewhat obscured by the cabinet overhang. Flip-out extension feet mounted on the bottom front of the cabinet would tilt the transceiver at a convenient viewing angle.

On the air performance was excellent and, except for some comments on VFO drift, reports were consistently good. Modulation quality was reported as excellent. Receiver drift was noticeable during warm up but, once stabilized, the receiver is a real pleasure to operate. I believe the logical approach is to accept the VFO as a bonus feature, to be used as a crystal substitute only as required. The dual band coverage and many other desirable features result in overall performance of the 62B that places it ahead of competitive factory assembled products on the basis of dollar value received. ... W4WKM

(Turn page for Specs.)

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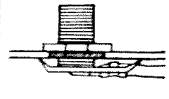
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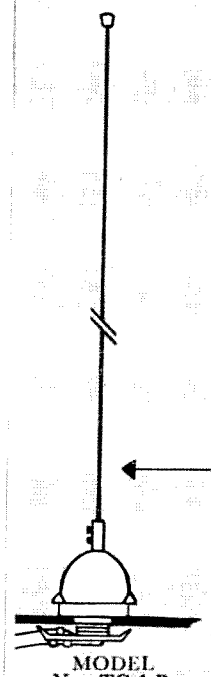
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TGM-R (no antenna)	$6.25

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138 Lincoln St., Manchester, N. H.

CONDENSED SPECIFICATIONS
Polycom 62B

TRANSCEIVER:

Frequency Coverage: 49.75 to 54.25 mc; 143.75 to 148.25 mc.

Tube Complement: 16 tubes, 5 silicon rectifiers, 3 silicon diodes and 5 gas regulators.

Antenna: 50 ohm line. Separate SO-239 Connectors for 6 and 2 meters with optional strapping for 2 band antennas.

Power Source (—20 to +10% of rated input voltage): 117 volts 60 cycle ac at 90 watts receive, 140 watts transmit, or 12.6 volts dc at 10 amperes receive, 16 amperes transmit.

Front Panel Controls: VFO-Xtal Switch, Receiver Tune, VFO Tune, Volume, Squelch, Antenna Trimmer, Band Switch, Driver Tune, PA Plate Tune, Antenna Loading and Meter Function Selector.

Size: 11" wide x 10" deep x 5" high.

Weight: 15 pounds.

Finish: Marine gray with maroon knobs and white lettering; brushed aluminum grill.

Accessories Supplied: Ceramic microphone with retractable cord, universal mobile mounting bracket, ac power cord and battery power cord.

Accessories, Optional: Base station microphone and 2 & 6 meter dual band antennas.

TRANSMITTER SECTION:

Type Circuit: Separate oscillator, multiplier(s) and straight through amplifier.

Plate Power Input To Final: 18 watts on 6 meters, 17 watts on 2 meters.

Modulation Capability: 85 to 100% at average voice level using plate modulation.

Hum And Noise On Carrier: At least 40 db down from 30% modulation level.

Harmonic Suppression: All harmonics and spurious emissions better than 50 db down.

Frequency Control: VFO or crystal.

Crystal Stability: ±.005% —30°C to +70°C.

Crystal Circuit Stability: ±.006% —20°C to +60°C.

VFO Stability: ±.02% —20°C to +60°C.

RECEIVER SECTION:

Type Circuit: Triple conversion superheterodyne on 2 meters, double conversion on 6 meters.

Calibration: 100 kc graduations every 4° with 6:1 tuning ratio.

Sensitivity: Better than .2 microvolt on 6 meters and .3 microvolt on 2 meters for 6 db S+N at 30%, 1000 cycle modulation.

Selectivity: —6 db bandwidth 8 kc ±2 kc; —60 db bandwidth 25 kc ±5 kc.

Delayed AGC: Audio output varies less than 3 db for inputs between 1 microvolt and .1 volt.

Squelch, Adjustable: .08 microvolt threshold on 6 meters, .1 microvolt on 2 meters.

Noise Limiter: Floating series gate type.

Audio Output: At least 2 watts into 2½" internal speaker or 3 watts into external 4 ohm speaker with less than 15% distortion at 1 watt.

Hum And Noise: Better than 40 db down from 1 watt output.

Frequency Response: Within +1 db to —5 db from 250 to 3000 cycles.

Image Rejection: 1st image better than 85 db down, 2nd image better than 60 db down and 3rd image better than 85 db down.

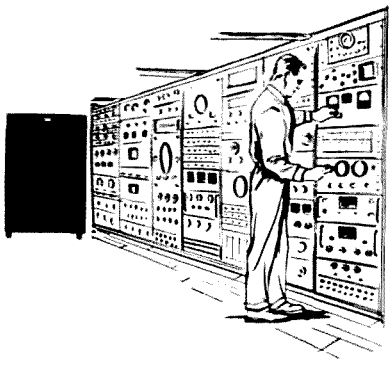
Spurious Responses: Better than 60 db down except within ±20 kc of desired signal.

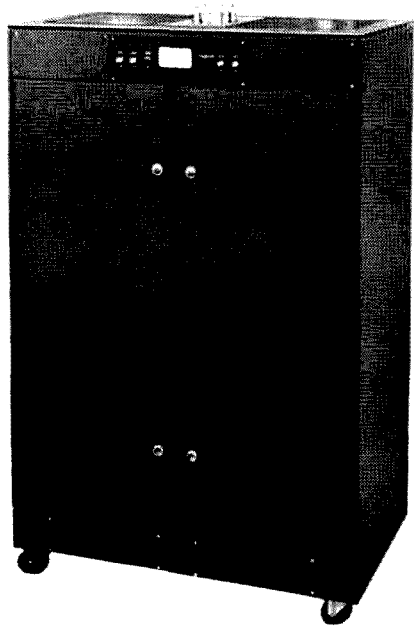
Internal Generated Spurious Signals: 145.17, approximately 90 microvolts (S9); 147.80, approximately 80 microvolts (S8).

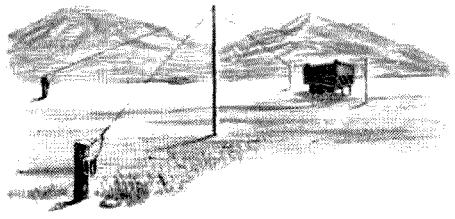
Cross Modulation and Desensitization: Better than 50 db down at ±20 kc.

IF Frequencies: 52.00 mc (±2 mc), 5.405 mc and 455 kc.

Stability: ±.06% from —20°C to +60°C.







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TER-500-70 U		DC to 30 mc	500	1000
TER-500-600 B	DA-199/U	DC to 30 mc	500	1000
TER-1800-300 U		DC to 30 mc	1800	3600
TER-3500-70 U		DC to 30 mc	1750	3500
TER-3500-600 B	DA-200/U	DC to 30 mc	1750	3500
TER-5000-70 U	DA-210/U	DC to 30 mc	5000	10,000
TER-5000-300 U		2-30 mc	5000	10,000
TER-5000-600 B	DA-201/U	DC to 30 mc	5000	10,000
TER-18KA-50 U		DC to 30 mc	18,000	36,000
TER-18KC-50 U		DC to 30 mc	18,000	36,000
TER-18KA-70 U		"	18,000	36,000
TER-18KC-70 U		"	18,000	36,000
TER-18K-600 B		4-28 mc	18,000	36,000
TER-18K-600 BF		4-28 mc	18,000	36,000
TER-25KA-50 U		DC to 30 mc	25,000	50,000
TER-25KC-50 U		"	25,000	50,000
TER-25KA-70 U		"	25,000	50,000
TER-25KC-70 U		"	25,000	50,000
TER-25K-600 B		4-28 mc	25,000	50,000

For companion RF Broadband Transformers refer to Sales Service Bulletin #8015.

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Request Technical Bulletin 8009



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Ham Radio in Finland

John Velamo OH2YV
Isokaari 4-B-30
Lattasaari, Helsinki
Finland

THE Finnish Amateur Radio League, SRAL, is among the oldest amateur radio organizations in Europe. It was founded officially in 1921, so this spring means the 41-year milestone to it. However, long before this there was considerably strong amateur radio activity in Finland; some of the still active Finnish amateurs were 'in the business' already around 1913-14, not to mention the actual pioneers who are not living among us any longer. Let us mention only A. Tigerstedt who developed the vacuum tube in a way that the Germans adopted as an important military secret that time. Leo Lindell OH1NA, silent key in 1936, is said to be the founder of SRAL, also the first Finnish radio amateur. In addition to these the amateur radio has many traditions in Finland.

The membership of SRAL (*S*uomen *R*adio-*a*matoori*l*iitto) is about 1800. Approximately 1600 of them are licensed amateurs. The country is divided into ten districts, OH1-OHϕ, OHϕ Aaland Islands having selfgovernment and thus counting as a separate country from Finland in the Amateur World. The maximum input power allowed to OH stations in the General class is 200 watts on 80-40-20-15-10 meter bands as well as on the VHF bands. There are possibilities that special permission will be granted to OH amateurs for operating on 160 meter band with a maximum of 10 watts input power.

The amateurs in Finland are divided into three classes: Technical, Novice and General Class. Technical Class requires knowledge of electrical and radio technics and regulations for amateur radio. However, no code speed is required. Novice Class requirements consist of basic knowledge of electrical and radio technics, code speed of 8 wpm plus regulations for amateur radio. General Class requirements are 12 wpm code speed, good knowledge of radio and electrical technics, considerably good ability to communicate on the bands, not to mention good knowledge of amateur radio regulations etc. In general the requirements are much like those in the USA. Technical Class license allows 200 watts on 144 mc and higher bands, CW or phone. Novice Class allows a maximum of 15 watts input power on 3510-3545 kc, 7020-7050 kc and 21060-21150 kc CW only, and the transmitter must be crystal controlled. After making at least 300 QSOs the Novice will be allowed to try to pass the General Class examination. The Novice class license is valid for a maximum of three years, and it will not be renewed. The General Class rights are those already mentioned.



W6AM visiting Finland in 1961 summer. OH2XK, OH2RM, K2RKN/OH2QZ, OH2XZ of U.S. Embassy, W6AM, in shack of OH2XZ.



OH2YV John Velamo, General Secretary of the SRAL of Finland, honorary Secretary of the Award Hunters' Club, President of the local radio club, member of A1-OC, Tops-CW-Club, HSC, Rcc, etc.

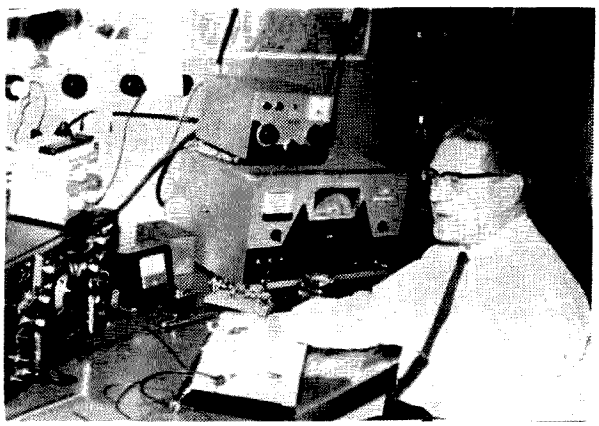
In Finland there are possibilities to any foreigner to get an amateur license and an OH call. However, this is based mainly on the reciprocal agreements, but many exceptions have been done, too. At the present time there is one American (OH2XZ), one Australian, and one Norwegian amateur licensed in Finland. Earlier there have been a few Englishmen, a few Swedes, etc. At the present time it seems that the Finnish authorities are in favor of the reciprocal agreements because applications of some amateurs of "non-reciprocal" countries have not been accepted. In Finland the authorities have given SRAL the rights to control the radio amateur activities; probably Finland is the only country in the world where the official league has such duties and privilege! This system is working well, and

violations against radio laws happen very seldom among the Finnish radio amateurs. The control work of SRAL is mainly advising but in serious cases SRAL has right to propose cancelling of certain amateur radio licenses. Thus the amateur radio activity in Finland is extremely free, however the system gives SRAL very serious duties and sometimes causes certain difficulties especially when violations are notified.

The DX activity in Finland is on a high level, as an average. The high top man probably is OH2NB with approximately 300 countries worked. OH5NW comes with some 260 countries on *phone* alone. Over 30 OH amateurs have more than 180 countries worked; they represent about 7-8% of the continuously active OH amateurs. The contest activity in Finland is high, especially in the international contests like WAE-contest, ARRL Competition etc., and before all the Scandinavian Activity Contest which usually show very strong OH activity on the bands. The number of OH's in these contests usually is among the highest in the whole world. SRAL issues three awards, OHA, OHA-100 and OHA-300, for contacting OH amateurs. Rules of these are available from Box 306, Helsinki.

Among other international activities in Finland there can be mentioned also the WDT and CRC awards, WDT being issues by the Tampere gang (OH3), and CRC award by the Radio Club of Cafe de Colombia (hi!). CRC has meetings *daily*, at the luncheon time, and thus it can be said to be the most active amateur radio club in the world! Furthermore, the oldest and original award and certificate hunters' organization, the Award Hunters' Club (AHC) has its headquarters in Finland. Newest addition to the Finnish certificates is the VRCC for the Finnish Railroads 100-year jubileum, issued by the railroad amateurs.

The local club activity in Finland is lively, too. There are nearly 30 clubs altogether, representing practically all Finnish cities. These clubs include most of the active OH amateurs



OH7NF Eino Toivanen, the 7 mc specialist with 156 countries on forty cw. Old Timer, one of the European pioneers on 28-mc—operating world-wide in the early '30s.



President of the OH YL amateurs, Marie OH2FB (XYL of OH2YV).

in their membership. The biggest of them is the OH2-Club, "Kakkosten Kerho," with a membership of approximately 300. The smallest clubs contain around 5-6 members. The Club stations usually have call signs beginning with the letter 'A,' OH1AA, OH2AA, OH5AC, OH6AB etc. The Headquarters call is OH2A, having also been used as OH4A, OH9A and OHϕA.

There are approximately 35 YL and XYL amateurs in Finland. A few of them are in the Novice Class. Their activities are not extremely strong on the bands; merely they seem



OH2NB Armas Valste, the top DXer of Finland. Old Timer, one of the first Finnish Radio Amateurs.

to like to arrange meetings. Mostly the OM's of the XYL amateurs are licensed hams, too.

The youngest OH amateur is OH2BAD, 13 years of age, good "runner-up" being OH2BL with 14 years of age. They both are still in the Novice Class but very soon they will be changing the final tube to bigger . . . The Novice Class system has given very good experience in Finland as to the operating ability and skill of amateurs. The General Class amateurs coming from the Novice Class regularly show a very good skill on the bands; this is

(Turn to page 77)

James G. Lee W6VAT
Box 45621
Los Angeles 45, California

An Extra Hand in the Shack

Dot Maker

MANY times while trying to track down TVI, BCI, Parasitics, etc., in a transmitter, two hands are just not enough to key the transmitter, tune an absorption wavemeter and TV set all at the same time. If there is someone else around to assist this is no problem, but when one is alone it is impossible to be in two places at once. "DOT MAKER" can help solve this and other problems.

The basic circuit, shown in Fig. 1, is a free-running multivibrator. This circuit is due to Courtney Hall[1], and is probably one of the simplest multivibrator circuits to be found. Yet, it is reliable, stable, consumes very little power, can be synchronized, and can be wired in only a matter of minutes. In Fig. 1, when voltage is applied, C begins to charge through V_1 and R_2; the current through R_2 cuts off V_2. When C has charged, V_1 cuts off. Since no more current is flowing through R_2, V_2 conducts and discharges C through R_1. The original condition is now restored and the cycle starts over again. V_1 and V_2 can be combined into a single tube envelope such as a 12AU7, 12AX7, 12AT7, and other similar types. Capacitor C may be switched to provide different rates, and if synchronization is desired, the grid of V_2 can be returned to ground through about 200K ohms and sync voltage coupled to the grid of V_2 through a capacitor. The output should only be taken from the cathode of V_2 since it is not very sensitive to loading impedances as is the cathode of V_1. V_2 acts as a cathode follower in this case.

The frequency is changed by changing the capacitor and/or the resistors. Making R_2 variable and switching in different values of C gives a very wide frequency range.

Referring to Fig. 2, the actual circuit of "DOT MAKER," one 12AU7 is used as a low frequency multivibrator to operate relay K_1, an 8000 ohm Sigma 4F relay. Its contacts key an external circuit by way of the terminal posts mounted on the edge of the Minibox. The second 12AU7 is an audio oscillator which can be used with phones, a speaker and output transformer, a pre-amp, or other reasonably high input impedance audio device for monitoring purposes. The 500K pot in the keyer gives a pulse rate of approximately 2 cps to 70 cps, and although this particular Sigma relay will not follow over this entire range, it does follow over a major portion. There are two reasons why just any relay wouldn't follow over the whole resistance range. One is that the current is drawn in short pulses and at the high resistance end of the pot, i.e., low pulse fre-

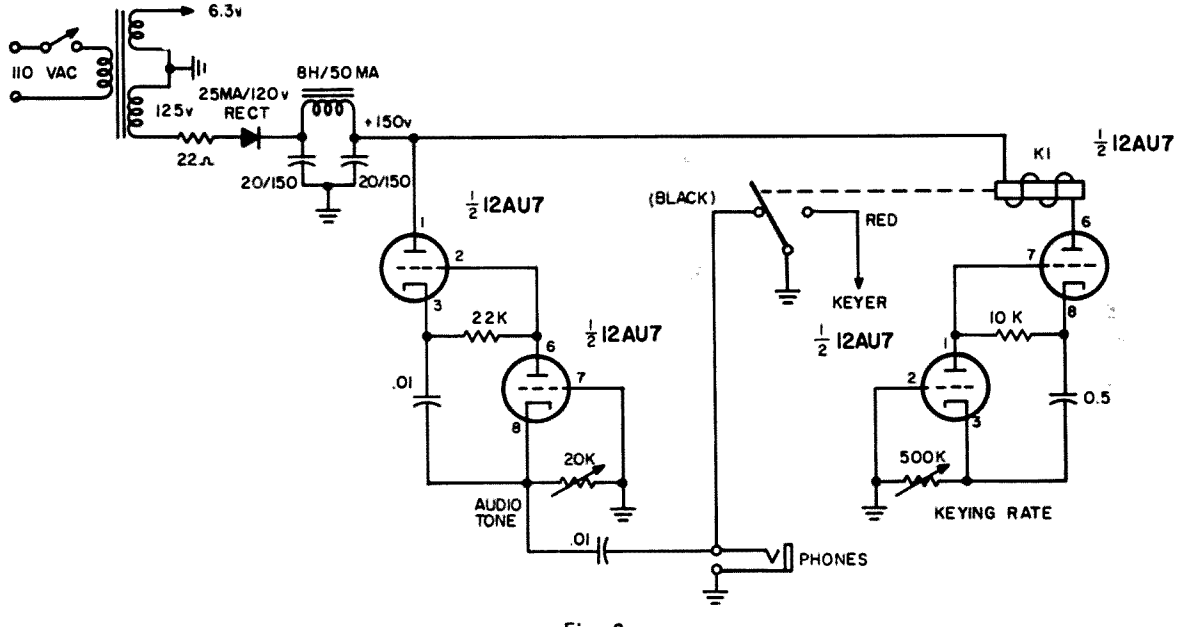


Fig. 2

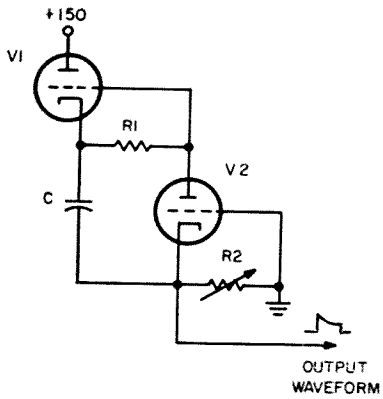


Fig. 1

quencies, it is not always enough to cause the relay to operate. The second is that at the low resistance end of the pot, the relay cannot follow because of the armature inertia.

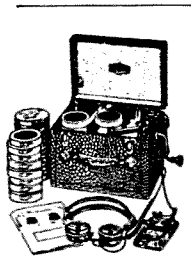
The Sigma relay used in this version has both adjustable contacts and spring tension, consequently it can be adjusted for maximum range. This is a desirable feature, although not absolutely necessary. As long as the relay will operate on 1 to 2 milliamperes no problems should be encountered. The armature contact need not be grounded if desired; however, if it is not, the insulation voltage of the relay may be exceeded when keying in certain circuits.

The audio oscillator may not appear very useful here, but it serves several purposes. Plugging a speaker and output transformer into the phone jack allows an audio monitor of the keying rate when checking for TVI, BCI, etc. For checking AM operation the pulsed audio can be fed into the modulator and the rf envelope synchronized on a scope for detailed examination. If desired, it can be wired separately from the keyer and used as a code practice oscillator or as a keying monitor.

The "DOT MAKER" is wired in a 3 x 5 x 7 inch Minibox and there is plenty of room to spare. The power supply is straightforward and the actual votage is not critical. Current drain is very small in this particular circuit. Wiring is not critical nor is placement of parts, so no special care is needed for the construction of the "DOT MAKER." Any way you use it, "DOT MAKER" will be that extra hand in the shack you've always needed.

. . . W6VAT

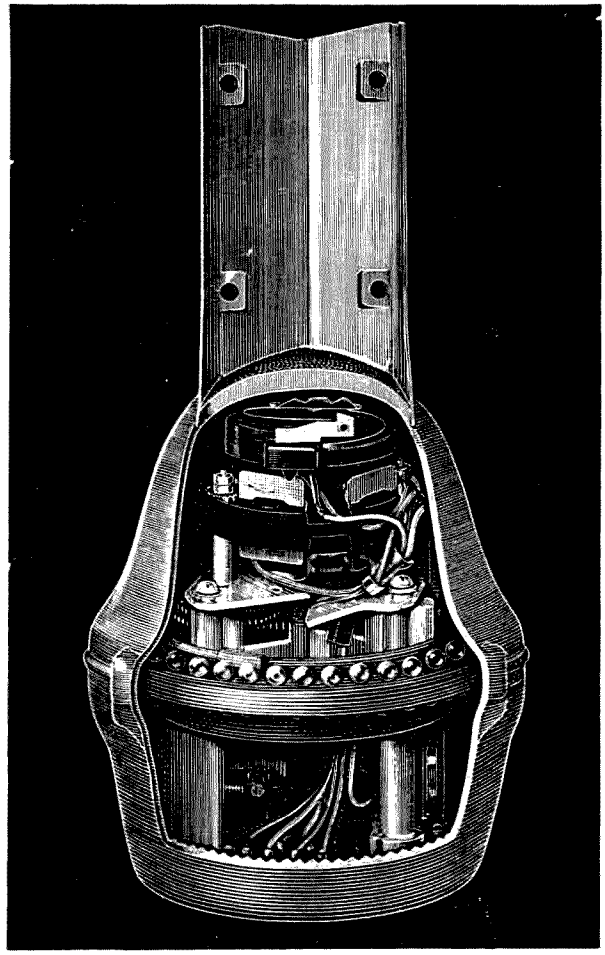
1—"STABLE FREE-RUNNING MULTIVIBRATOR," Courtney Hall, p. 38, July 1960, Electronic Equipment Engineering.



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An Accurate S-Meter

Jim Kyle
1851 Stanford Avenue
Santa Susana, California

WOULD you like to be honest, for a change, in the matter of giving signal-strength reports?

Those are strong words, yes, but if you rely on the scale of your receiver's S-meter and blithely quote a "60 db over S-9" reading, you're being far from honest. Let's take a closer look and see why.

To start, let's assume that our ancient tradition that one S-unit equals a 6 db change in signal strength is true. That means that every S-unit change in level doubles the voltage present at the receiver input.

Let's also assume that the non-existent "S-0" level represents a signal just exactly equal to the noise level of the receiver and the band in use. On 10 meters, this is usually equivalent to about 10 microvolts fed into the antenna terminals.

Now since every S-unit represents a doubling of the voltage at the antenna terminals, S-1 would equal a 20-microvolt signal. S-2 would be 40 microvolts, S-3 80, and so on until we find that S-9 equals 5,120 microvolts or 0.00512 volt. At S-9, we begin running into "db over"; these usually increase 20 at a whack—but 20 db represents a tenfold increase in input voltage. Thus, "20 db over S-9" would be 0.0512 volt, "40 over 9" would be just over half a volt, and "60 over 9" would be a whopping 5⅛ volts! The largest voltage yet recorded at the input terminals of a receiver which wasn't connected directly to a transmitter is only a bit over 1 volt; therefore, unless the scientists who measure received signals are all wet, a "60 over 9" signal is just an optimistic figment of our imaginations.

The blame, though, doesn't rest entirely on our shoulders. Virtually every receiver built today which includes an "S-meter" is graduated to 20, 40, and 60 db over S-9—and the needle stays there much of the time, on most bands.

These S-meters have other faults, too—earlier we said let's assume that one S-unit equals a 6 db change in signal strength. With most S-meters, this is not so. The spread between S-1 and S-9 is actually 256 times, in voltage input, but most meters swing their needles across this range with less than a 10-time voltage change.

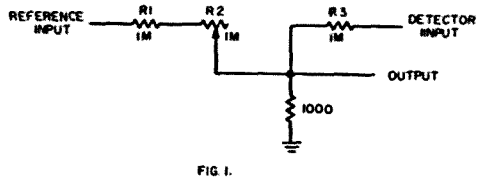


FIG 1.

If you want more of a sales talk, read almost any of Ed Tilton's writings—he has long conducted a campaign against meaninglessly inflated "S-Meter" reports; the purpose of this article isn't so much to convince you, as it is to show you what you can do about the situation for yourself.

You can build an *accurate* S-meter, capable of measuring incoming signals to the decibel in the range S-0 to S-9, for under $10 (less, if your junkbox is well-stocked). The accompanying schematic shows the circuit; here's how it works:

Basically, this "S-Meter" is a balancing type voltmeter measuring the voltage across the detector load resistor in 6 db increments, with a *fine* adjustment to allow continuous interpolation between the steps.

The voltmeter consists of three basic circuits: a reference voltage source, providing 10 reference voltages in 6 db switched steps; a "Kirschoff adder" which adds together the reference voltage and the input voltage; and an output indicator to show us when the output voltage is zero.

If the meter is adjusted to give zero output when both the *coarse* and *fine* knobs are set at "0" and the receiver is bringing in only noise, then the strength of an incoming signal in S-units and db above the noise level can be quickly determined by re-balancing the meter with the two knobs until the indicator once more reads "0", then reading the S-units from the *coarse* scale and the "db over" from the *fine* scale.

The heart of the circuit is the "Kirschoff adder," consisting of three fixed resistors and a potentiometer. This circuit is shown separately in Fig. 1; you can see that resistor R1 and pot R2 form one leg of a Tee, while resistors R3 and R4 form the other two legs.

With the resistance values shown, and R2 in its zero-resistance position, the two input voltages are added together algebraically and their sum appears at the output. However, since the reference is positive while the de-

tector voltage is negative, this "addition" will result in an output voltage of zero if both inputs are equal.

Now let's take another look, but assume that R2 is in its maximum-resistance position this time. Now, the output voltage will be proportional to the algebraic sum of the detector voltage and *half* the reference voltage; the reference voltage has been multiplied by the ratio of R3 to R1+R2.

Actually, the output voltage is only proportional to the sums of the input voltages in both cases, because R4 acts as the lower leg of a voltage divider. Since we are interested only in one output voltage—zero—this fact is not important.

The maximum-resistance position of R2 corresponds to the +0db scale reading, and the zero-resistance position is the +6db scale reading. By switching the reference voltage in 6 db steps with R2 set to +0db, the *coarse* adjustment covers a range of detector voltages from approximately 1/16 volt to approximately 32 volts. Adjustment of the *fine* pot (R2) expands this range upward to 64 volts. Few receivers will handle a 64-volt signal level at the second detector, but most will produce 1/16-volt output with only noise input.

At this point, you may be wondering what will happen to detector performance, with a path from B+ to the detector. Here's where the voltage divider formed by R4 comes in. At its worst, the positive voltage at the top of R4 can be only 1/1000 of that at the top of the reference string—or 0.064 volts. This is further cut down by isolation through R1 and R2, to only microvolts at the detector.

The low voltages across R4 also make necessary the rather elaborate zero-indicator system composed of V1 and its associated resistors, in addition to the 50-0-50 microammeter. This circuit is a conventional bridge-type VTVM except that the cathode resistances are higher than normal; the meter indicates the difference in current flow in the two halves of the tube.

When the S-Meter is balanced, the current flow will be equal and the meter needle will rest in the center of its scale. When the S-Meter reading is weaker than the incoming signal, the needle will be above center; when the S-Meter reads less than the incoming signal strength, the needle will be below center.

Resistance of R2 in Circuit	Scale Calibration
1 meg	+0
782 k ohms	+1
589 k ohms	+2
415 k ohms	+3
262 k ohms	+4
125 k ohms	+5
0 ohms	+6

Table 1. Calibration of R2 Scale.

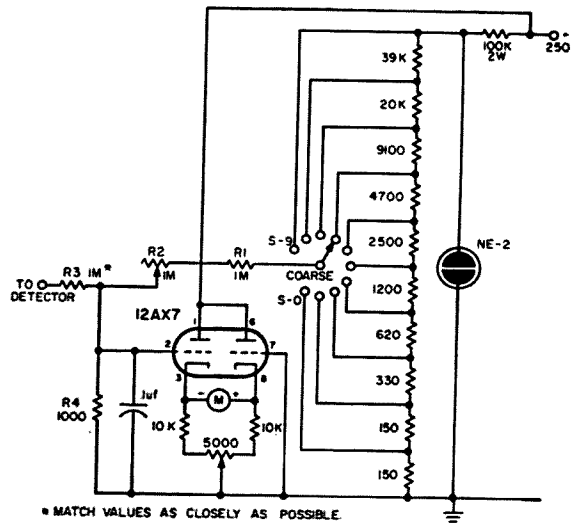


FIG. 2

The meter used was chosen for price; Lafayette Radio sells this model for $2.95. However, you can use any meter of similar current capacity you may have; the zero-center feature is not necessary, since a zero-set adjustment is provided in the meter circuit. To use a zero-left meter, simply adjust the zero-set until the needle rests in the center of the scale with the indicator disconnected from the adder and the R4 terminal of the indicator grounded.

The only critical part of construction and installation concerns R3—this resistor should be located right at the detector load resistor, and a shielded lead run from it to R4. The rest of the circuit can be an outboard unit. Power can be taken from any source capable of supplying 10 ma at 200 to 300 volts dc and 600 ma at 6.3 volts for the filament.

To use the S-Meter after it's built and installed, start by setting both the *coarse* and *fine* knobs to their zero settings. Turn the receiver to the band in use, and disable the AVC by switching to *manual*. Find a vacant spot on the band. Using the receiver RF and/or IF gain control, balance the S-Meter for a center-scale indication. This calibrates the instrument to the prevailing noise level for the band, the receiver, and the particular conditions at the time.

Now, secure the receiver rf or *if* gain control in position with a strip of masking tape. If it is moved, you'll lose calibration. Tune across the band to signals, and at each signal you want to measure, balance the S-Meter with the *coarse* and then the *fine* knobs.

Note that the *fine* knob provides only an increase, not a decrease, in indication. Start with both knobs at zero; the needle will be to the left of center. Increase the *coarse* setting until the needle moves to the right of center, then decrease the *coarse* setting one unit and center the needle with the *fine* knob.

When you have the receiver calibrated to the meter, you'll occasionally find signals which

overload the set; if you take the time to calibrate the gain control as well, you can then back off and handle them too.

To calibrate the gain control, disconnect the receiver from the antenna and hook up a signal generator. Turn the gain control to maximum, and balance the S-Meter with the two knobs. The S-Meter reading is immaterial, but for convenience the signal generator should be adjusted so that the reading is somewhere between S-9 +0 and S-9 +6.

Mark this position of the receiver gain control "0". Next, set the S-Meter *coarse* control one unit lower; leave the *fine* knob alone. Using the gain control, rebalance the meter. Mark this position of the gain control "+1". Move the *coarse* control another unit lower and rebalance with the gain control as before, marking this position "+2". Continue in this fashion until the gain control is completely calibrated.

If you run out of range, losing the signal or going below "S-0" during this procedure, return to the last accurately calibrated position. Then move the *coarse* control back to S-9 and increase signal-generator output until the meter is rebalanced (you can use the *fine* control to rebalance after the signal generator output is in the right range). This establishes a new reference level, and you can continue calibration.

To use the calibrated gain control with the S-Meter, first proceed as before—tuning to noise, setting both *coarse* and *fine* controls to zero, and balancing with the gain control. Now, note the gain-control reading. When you run into a signal so strong that it overloads the receiver, back the gain control down an integral number of steps (if the original reading was +4½, you can back it down to +5½, plus 6½, +7½, but not to +7 or +6). Note how many steps you moved, and add this number of S-units to the strength you measure (if you moved down four steps and read S-9 plus 5, the true reading would be S-13 plus 5 or in more conventional terms, 30 over 9—but you won't find this kind of signal around).

. . . K5JKX/6

PARTS LIST

1 single-pole, 10-position rotary switch (COARSE Control)
1 1-megohm, linear taper potentiometer (R2)
1 5000-ohm, linear taper potentiometer (ZERO SET)
1 50-0-50 microammeter (Lafayette TM-13 recommended; any 50- or 100-microammeter will work)
1 9-pin tube socket
1 chassis box
knobs, panel decals, wire, and solder

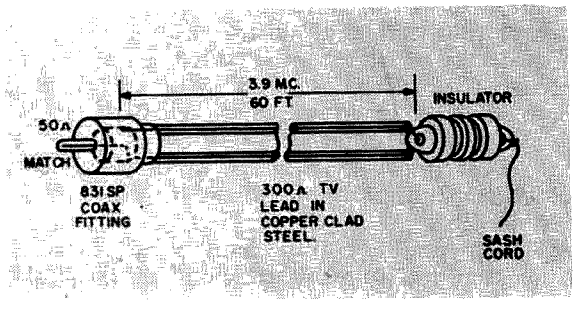
LCU's Michigan Long Wire

3.86 = 60'6"

Ralph Burch W8LCU

THE following antenna was designed to be used with a 35 watt, 75 meter station which I spent a great deal of time installing in my 1959 Shasta camp trailer.

The thing that really got me into trouble was falling over tent stakes and getting mixed up in campers clothes lines while trying to erect a 75 meter doublet in one of many Michigan parks. Right then and there I knew I would have to come up with a new approach on portable antennas.

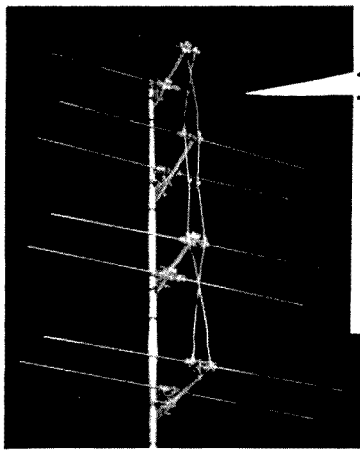


The antenna had to meet certain specifications:

No. 1. It couldn't take to much space.
No. 2. It had to be erected easily in a minimum amount of time.
No. 3. It must be supported at one end by the trailer making it easy to fasten the other end to some convenient tree, post, or mast.
No. 4. The antenna must be fairly efficient.

With this goal in mind, I set out to design what I call the LCU portable antenna.

This antenna consists of nothing more than a piece of copper clad 300 ohm TV ribbon cut exactly 60 feet long (for 3.9 mc). At one end the ribbon is fed into a standard coax fitting and one wire is soldered to the shield or ring.



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The other wire is fastened to the center. At the other end the ribbon is simply shorted together with an insulator installed (see sketch). Fastened to the insulator is about 30 feet of heavy sash cord.

On the trailer near the top on one side, I am using a 4 inch coax feed thru fitting. On the inside of the trailer I use approximately 3 feet of 50 ohm coax to get to the station. In addition to the antenna system, I have a small metal stake with a wire about 3 feet long and a battery clip fastened to the end.

Once I have arrived at the desired camp site and parked the trailer, all that is necessary is to screw the coax fitting on the feed thru near the top side of the trailer, pick out a convenient tree about 65 feet away, tie a pair of pliers or a weight on the sash cord, toss it up over a limb, pull the antenna tight, push the ground rod in and fasten the battery clip to radio ground. Then on the air I go.

In every case the antenna height should be 8 feet above ground at the trailer end and about 30 feet at the far end.

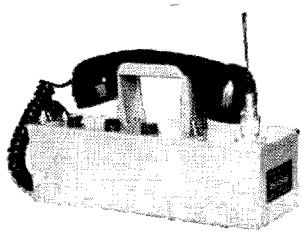
The antenna is essentially the same as a commercial Unipole which normally sets vertically with 4 radials at 90 degrees and the impedance match is approximately 50 ohms. This antenna works somewhat the same except it is erected horizontally. The return wire to ground lowers the ground resistance, causing the antenna to radiate more efficiently. This antenna doesn't radiate as well as a folded dipole, however, its efficiency is very close. At 3.9 mc the swr should be 1.5 to 1 or less.

Height has a great effect on the feed point impedance. In other words, if the antenna wire were raised at the feed end the swr might go up as high as 5-1. Whenever the antenna is used under the conditions listed, its efficiency is at optimum.

The same antenna could be used on many other frequencies, in fact it lends itself beautifully to 160 meter operation. The formula for figuring the length in feet for the 300 ohm ribbon is 234 divided by frequency in megacycles.

I hope this will give some of you fellows some new ideas on portable antennas. . . . W8LCU

WALKIE-TALKIE RADIOPHONES



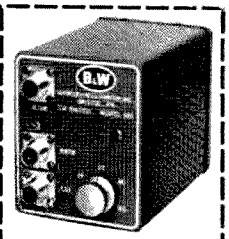
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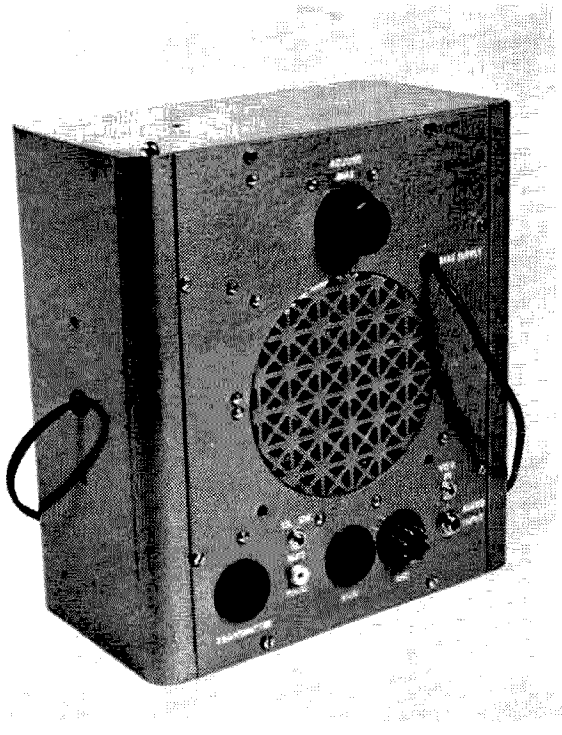


Fig. 1. 5" x 9½" x 10½" loudspeaker cabinet containing interconnecting circuitry for a ham station transmitter and receiver. The knob at the top is for adjustment of the operating bias for the transistor break-in circuit. The cord at the right connects the negative power supply which is used to cut off the TR switch. Across the bottom are transmitter plug, bias jacks for the TR switch and final amplifier, accessory plug, receiver plug and, at the extreme right, the VOX input and audio input jacks.

Picture by Deane Bond

THE small size and relatively simple wiring layouts for transistors make them lend themselves to small equipment units without requiring special miniaturizing techniques. The station control unit shown in Fig. 1 is a good example. The speaker box, which is 5" x 9½" x 10½" in size, houses all of the accessories required to connect a transmitter and a receiver together to form a complete station, except a small bias supply and a TR switch. There is enough space left in the box for these also, if desirable.

The speaker box contains a 5" x 9" oval speaker, a W5LAN "Transistorized Electronic Key," (QST, May, 1959), an AC supply for the key, a "Break-In a la Transwitch" circuit, additional transistor circuitry to provide for VOX operation without relays and all of the necessary wiring to interconnect the transmitter and receiver.

Fig. 2 shows the interior of the box. The transmitter and receiver plugs are extended to connecting blocks to simplify inter-connection. The plugs and connecting blocks are attached to the removable back of the loud speaker cabinet. Jacks for taking cut-off bias to the TR switch and final amplifier make it easier to rearrange the station or to remove a unit for servicing.

Also fastened to the cabinet back is a home-

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made chassis on which is mounted the "Transwitch" circuit. A multivibrator circuit, connecting the transmitter "VOX" circuit to the "Transwitch" circuit, and a bias circuit for cutting off the final amplifier while receiving have also been mounted on the chassis. This circuitry will be the subject of a later article.

Notice the small line-to-voice coil transformer at the lower right. This is used to permit taking the receiver output through the "anti-trip" circuit in the transmitter at a 500 ohm impedance level, cutting it to 3.2 ohms for the speaker voice coil. This increases the amount of control available for adjusting the anti-trip feature.

Inside the speaker cabinet can be seen the "Electronic Key" unit and the loudspeaker. Out of sight at the right is a small 22½ volt dc supply for the "Key." This accounts for the power cord seen in Fig. 1. Controls for the electronic bug and the "Muting Level Control" are mounted on the face of the cabinet.

The construction of the unit is as simple as the pictures make it appear. There is plenty of space under the transistor chassis for all of the resistors, condensers and wiring for the circuits without crowding or creating difficult assembly problems.

The box is adequately ventilated to dissipate the small amount of heat generated in the circuits.

This unit was developed to permit using the main station HT-32 and SX-88 in our 23 foot house trailer for those times when weather or darkness keeps us off our favorite mountain lake. The whole assembly is powered by a light plant mounted in the trunk of our car. But that's another story! . . . W7AXJ

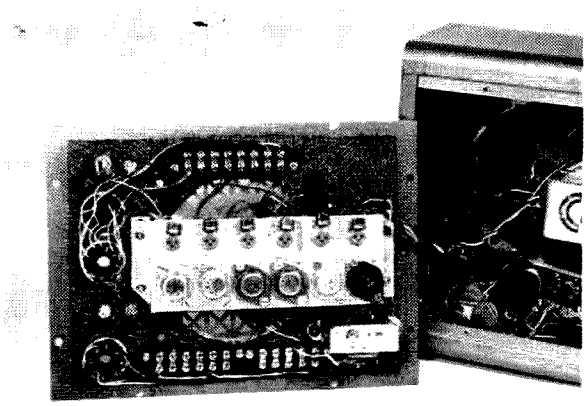
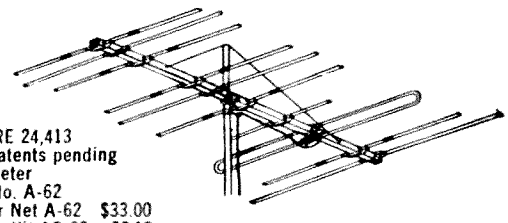


Fig. 2. Interior view of the control unit. The receiver and accessory plug are at the left, wired in parallel and extended to the connecting block at the top. The transmitter plug and connecting block, similarly connected, are at the bottom. The line-to-voice coil transformer is at the lower right. Across the middle is the transistor chassis. Inside the box can be seen the electronic bug components and the loudspeaker.

Picture by Deane Bond

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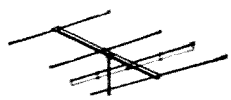
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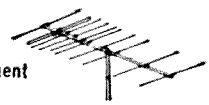
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A Universal Antenna

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Comparative Measurements

John Ellison W6AOI
1720 Holly Ave.
Capt. U.S.N. (ret.)
Menlo Park, California

THE designation of universal antenna has been applied to a variety of antenna configurations but invariably there are certain implied limitations which are inherent in the system. The antenna described herein is perhaps more justifiably entitled to the term of "universal antenna" from several viewpoints. Before enumerating them, let me hasten to disclaim any "exotic circuitry," "sophisticated configuration" or "technilogical breakthrough!" This is a review of a time-tested horizontal antenna system in the light of present day knowledge and equipment available to the amateur which can assure proper adjustment for maximum performance.

The designation of universal antenna is applied chiefly for two important reasons, first, the system may be operated with no compromise of efficiency on not only any amateur band from 160 meters to 10 meters but also on practically any other frequencies between the amateur bands, such as are used for Army, Air Force MARS and the Naval Communication Reserve. Second, the antenna can be erected on practically any residential lot and lends itself to nearly any conceivable topographical arrangements of trees, houses and the like. Considering these two reasons we note that perhaps the chief perennial problem that besets the amateur seeking a suitable antenna system is not lack of information but rather an excess of information, so much so that he can scarcely make a satisfactory selection in view of the different limitations of the various systems. Just to mention a few in passing (which will probably strike a familiar nostalgic note for many), system A requires the shack to be about mid-way between the skyhooks, system B requires bringing the antenna hot end through the house to the shack location, system C requires a good *short* ground connection (and the radio shack is on the second or third floor!) system D requires tuned feeders (which are invariably too long or too short) system E will work on only one band, system F requires a few acres, system G requires only one mast (about 100 feet high!) and so on. Everyone can recall going through this phase of deciding on what to put up and where. Most of our amateur heritage of antenna knowledge stems from the time when all transmitters were home-built, and band-switching transmitters were not too widely used. With such transmitters a single band or two band antenna was adequate. However, with the present day commercially built complete transmitters or kits, there exists a transmitter capability which cannot be exercised with many of the simple antenna systems in vogue. Even though the operator may confine his operations largely to one or two bands, he would like to "visit occasionally" on some of the other bands. He may also want to join the MARS or NCR nets, although this desire is frequently circumvented as much by the frequency limitations of commercially built equipment, as by inadequate antennas.

Suppose we start off in pedagogical fashion considering what we would like to have in performance versus what we can reasonably achieve. Consider first the question of antenna height. Height in absolute terms is necessary only to get reasonably clear of adjacent structures. With reasonable clearance of this nature, height becomes related to frequency and is more properly considered in fractions of wavelength rather than in feet. In terms of wavelength, if we want to get low angle radiation of 30° or less we have to get the antenna up at least a half wavelength above ground. It is immediately apparent that for 160, 80 or 40 meters we are not about to get up high enough with any supports that are economically or physically within the grasp of the average amateur. So we accept this fact and consider what we *can* get with limited height and we learn that the major radiation we will get is mostly high angle, 60° or more. Actually, this is *not* a serious disadvantage since it gives us fairly solid coverage within the range of most contacts on these frequencies, under average propagation and QRM conditions. By the same token, there is comparatively little directivity experienced so

that for all practical purposes the antenna is omnidirectional. This feature is particularly attractive for Net operations.

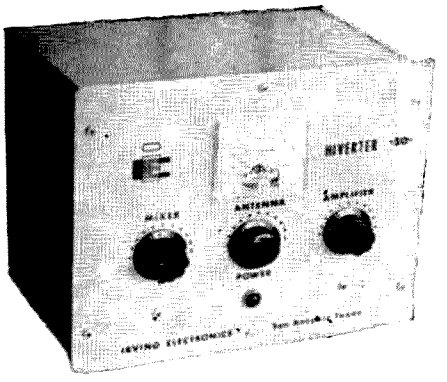
Last but not least, there is considerably greater freedom from multipath transmissions (fading) with high angle radiation. On 20, 15 and 10 meters (when they are open) where long distance contacts are sought we would like low angle radiation, and at these frequencies a half wavelength or more in actual feet becomes quite reasonable. So in summary, we may properly conclude that an average height of 35 feet would be quite satisfactory for an all-band antenna, or even as low as 30 feet will not be unacceptable. This height is easily within the reach of any amateur in view of house and tree heights and economical telescoping TV antenna masts. This is one of those rare occasions where what we can attain within reason is just about what we would like to have.

Next let us discuss the questions of antenna location and length. These two must be considered together. Naturally, the antenna must be located reasonably in the clear if we are not to lose too much power by absorption in adjacent structures in the strong antenna field. However, clear areas may not accommodate the required length, and in many cases, the length required for a low frequency antenna just isn't available anywhere on the property. In these cases we are told that we can bend the low current ends without reducing the efficiency seriously, and thereby squeeze the antenna into the available space. Now, if it were possible to combine the bent end with the flat top to get the length and use the former as the feed system we would be getting closer to an answer. There are disadvantages in bringing the antenna end into the shack, but if we bring the bent end down to a matching network, several desirable aims may be achieved. We may bring the bent end down wherever it is physically and electrically most suitable, the bent end/feeder end reduces the linear space required for a given antenna length, the matching network may be connected at the bent down end where it is conveniently accessible for tuning and adjustment, the antenna can be tuned to any desired frequency or harmonic and the matching net can be fed with a low impedance line such as coax of any length running to the transmitter location.

Now that we have reviewed the general picture, let us get down to practical cases. First, it must be realized that this is a fundamental and harmonic operated antenna, and as such, has no gain over other fundamental or harmonic antenna types.

However, as distinct from many other types, it operates as a resonant system without compromise of efficiency on any frequency to which it is tuned, it may be conveniently and accurately tuned to any desired frequency and

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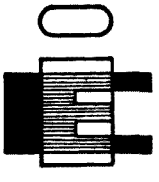
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it may be fed with a flat (non-resonant) line of any convenient length. This insures the maximum performance of the antenna as a radiating system and the maximum freedom from critical feeder lengths when changing frequencies.

The antenna height has previously been indicated as 35 feet. The over all antenna length should be chosen so that it is slightly short for the highest frequency we expect to use. The purpose in making the antenna slightly short is to permit resonating it to any desired frequency or harmonic with a loading coil only. If we just picked a random length we would find some frequencies where a series condenser instead of a series coil would be required. This would introduce an additional tuning element with no compensating advantage. So we make up a table using the Handbook formula for lengths at various frequencies.

$$\text{Length (ft)} = \frac{(\text{Number of half waves} - 0.95) \times 492}{\text{Freq. in mc}}$$

Freq	Resonant Mode	Length inFt.
3295	½ wave	142
4000	½ wave	117
7300	1 wave	131.5
7832.5	1 wave	122.5
14350	2 wave	135.7
21450	$\frac{5}{2}$ — or 3 wave	113.5 or 136.5
29700	$\frac{7}{2}$ — or 4 wave	115 or 131.7

From the above table we select the maximum length of our wire antenna as 113.5 feet and then reduce *that* figure by an allowance for the length of the ground lead and something for the resonating coil. Actually, in practice, it turns out that a length of about 105 feet is satisfactory, but it can be even less, realizing that a shorter length simply requires more turns on the resonating coil. This 105 foot length is the length of the flat-top portion plus the vertical portion down to the coupling network. If the vertical portion is 35 feet, we need a horizontal top of 70 feet. If space does not permit a 70 foot run, bend the far end down or sideways to get the required over all length. As you can see, the length is not too critical.

Resonating and Coupling System

The downlead of the antenna is tapped onto a coil which in turn is connected to the matching network. It will be necessary to be able to tap onto *any* turn of the coil for reasons which will be explained later. Hence, for the antenna coil a 38 turn coil, 3 inches in diameter at 8 turns per inch is used. This is half of a standard ten inch length of AIRDUX #2408 and with the 8 turn per inch pitch it is possible to clip on to any turn. There is one catch I should warn you about right here! Note that if a coil is at the very end of the antenna where it connects to the matching network the vanishingly small antenna current makes the coil inductance almost ineffective. But if we put the coil *in* from the antenna end a few feet we have moved up on the antenna current curve sufficiently to get an inductive loading effect with a reasonably small coil. In the actual antenna herein described, the 38 turn coil (52 microH) and a 3 foot lead from the coil to the coupling network made a suitable combination.

The coupling network is an L net which must match the end impedance of the resonated antenna to the impedance of the coax feedline. An L net is the simplest and most efficient form of impedance matching known but as a rule it is not a trial and error device. Usually, the two impedances to be matched must be known within a few percent, whereupon the calculation becomes very simple. For the sake of completeness, I am going to digress briefly on the subject of end impedance of a resonant antenna system. This is not a rigorous approach nor on the other hand is it "cracker-barrel" theory,—let's call it a median approach. The technical literature is quite vague on the subject at hand unless you have infinite time and unlimited access to all printed matter. The value of the end point impedance is affected by the height above ground, wire size, proximity to structure, antenna configuration, mode of operation and other variables, —probably including "Murphy's Law." With so many intangibles to reckon with, the best we can do is to take a statement in the reference books that tells us that for a half wave antenna a quarter wave above ground the end impedance is on the order of 15,000 ohms. As the frequency is raised the physical height in terms of wavelength changes and the impedance becomes less, the minimum value being on the order of 3000-3500 ohms for wire antennas. This is of interest only when making the first approximations to get started on the L net design. From experimenting with this antenna to achieve a practically perfect match, and then from the net values working backwards to calculate the antenna impedance, it appears that the maximum value (which occurs at half wave operation at the lowest frequency) is between 9000 and 10,000 ohms. This means in actual practice, that the L net constants for all our purposes can be met with a multi-tapped coil whose maximum inductance is about 45 micro-henries and a variable condenser with a 20-120 mmf. range.[1] The remaining half of the 10 inch length of AIRDUX coil will do admirably for the L net inductance and should have about 12 taps run from it to a switch. One word of caution,—the

end voltages are high! The condenser should have spacing for 1500 volts for medium power rigs and 2000 for high power rigs and the switch should have comparable insulation. The coil should be tapped to short out turns from the maximum value about as follows:

Table 1.

Tap	Active coil turns	Approximate band suitability
1	whole coil	
2	29	80 meter
3	25	80 meter
4	21	
5	16	40 meter
6	14	40 meter
7	12	
8	6	
9	5	20 meter
10	4	20 meter
11	3	15 meter
12	1	10 meter

The antenna coil taps may vary considerably from one installation to another because the antenna end impedance will vary with the local installation conditions but in general they will follow this pattern:

Table 2.

Freq.	Active coil turns
3.3	38.5
3.6	36.5
3.8	36.5
4.0	36.5
7.15	17.5
7.83	12.5
14.3	8.5
21.3	3.5 or 9.5
29.0	1.5 or 7.5

Tuning and Adjusting

The antenna, network and transmitter are connected together as shown in Fig. 1.

Since we do not know the end point impedance of the resonant antenna at the various frequencies we have to get the proper match indirectly. We do know, however, that there are three points on a resonant antenna where the current and voltage are 180° out of phase, namely, at the middle of a current loop and at the ends of the antenna. At these points, and only these points, can we get a purely resistive load, without providing some reactance compensation in the coupling device. So, to get the antenna resonant we use a SWR bridge or preferably a reflected power meter (or directional coupler, as it is also called) in the coax line. Then, if we can effect a proper impedance match the transmitter will load to its proper value.

1. For theory of L net design see GRAMMER, QST, March 1957. For practical application to antenna matching see my article CQ, July 1960.

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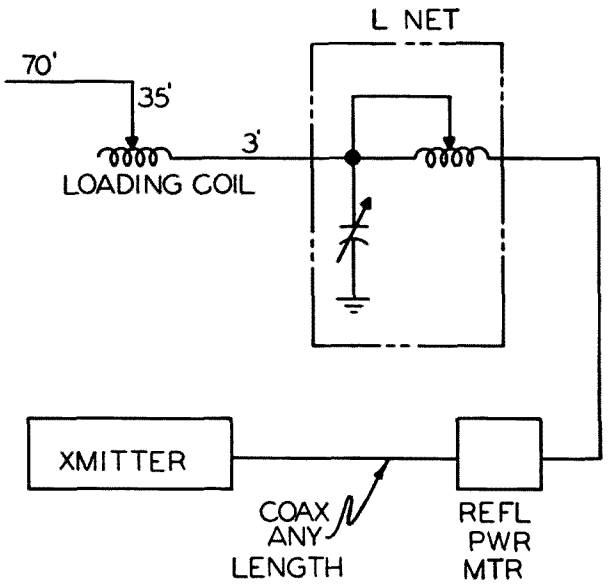
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Because of interaction among the various elements of the system, the following adjustment method is recommended as the simplest and most foolproof. Since the L net acts not only as an impedance matching device but is also capable of compensating to a minor degree for a reactive component in the antenna it is necessary first to have one part of the entire system accurately and finally set, and second to have a means of measuring power transfer. The one part that must be set first is the transmitter. It must be tuned up to a *non-reactive* load (resistors only!) and its control settings logged and kept constant while the remainder of the system is adjusted. You understand, of course, that this procedure is necessary only when making the first adjustments of the entire system. Once the settings of taps, condensers, controls, etc. are found they can be recorded and thereafter changing bands is quick and accurate,—and dependable. This eliminates, permanently, the oft-repeated phrase on the air, "Just a moment while I dip my final tank." This is not only unnecessary but if resorted to will definitely "louse up" the entire system. This may come as a terrible blow to the characters who like to "peak it up a bit." The second step requires *as an absolute necessity,* a reflected power meter. Either buy a kit or build the one in the late ARRL Handbook. The latter is simple and easy and inexpensive, and may be left in the line as a continuous monitor.

The actual detailed steps are, first, tune up the transmitter to the dummy load of 52 ohms. You can and should use reduced power for this tune up as long as you maintain the ratio of plate voltage to plate current the same as it will be at full power. This maintains a constant "generator impedance" from the final into the transmitter coupling system to the coax line. Next, couple up the transmitter to the coax line, coax line to the L net and L net to the antenna and loading coil. Set the L net inductance tap and the antenna coil tap from tables 1 & 2. Set the reflected power meter to read reflected power and the transmitter at reduced power and tune the L net condenser through its range while observing the reflected power. There will be some setting where it will be lower than anywhere else. Then add or subtract antenna coil turns, retuning the L net condenser each time, until the reflected power goes practically to zero, which it will at some setting. This establishes antenna resonance for that particular frequency,—all your power is going out. Then check the transmitter loading at normal power input. If it is low or high, reduce or increase the L Net inductance and retune the L net condenser for minimum reflected power. This establishes the proper impedance match to give proper transmitter loading. The question may arise regarding the use of a Pi net or link coupling between the antenna and the coax rather than the L net. Calculations will show that since an L net is a rudimentary Pi net (one condenser having zero capacity) any other Pi net will of necessity have a higher Q than an L net. Since the high impedance transformation already requires a high Q, we would prefer a system which has the least "high Q" to obviate retuning within a band, —this dictates the use of the L net. The mechanical considerations, inflexibility and unpredictability of link coupling rules it out completely for this use. Another word of caution on constructing this antenna system. A moment's consideration will make it immediately apparent that the 3 foot length of antenna between the loading coil and the L network will be extremely sensitive to any physical movement since it has a small capacity to ground which in effect is "tuning" a large inductance. Any shift in position of the 3 foot length will throw off all your various band settings. You can avoid this by using a rigid rod (such as a 3 foot length of one-eighth brass brazing rod) mounted on stand-off insulators between the antenna loading coil and the L network. If this is done before any tune up measurements are made you will avoid a lot of trouble. This effect we are dodging is similar to the detuning effect of the swaying tip on a mobile antenna.

Operation

Because the antenna is loaded with lumped constants, the Q is higher than with a conventional full length wire antenna. This means in practice that retuning will be required if the percent frequency change is large, such as when going from one end of the 80 meter band to the other. However, not many transmitters will accept such wide frequency changes without retuning, either. You will find when using this antenna for receiving, that the high Q is a distinct advantage as it peaks up noticeably those signals which are in the

pass band. Also, in retuning from say 3.5 kc to 3.9 kc it is possible to change either the antenna loading coil or the L net condenser. It is easier in practice to find one antenna coil tap for an entire band and use the reactance compensating feature of the L net which occurs automatically when retuning the L net condenser for minimum reflected power.

The use on 160 meters has been deliberately avoided up to now because it differs from the procedure on all other bands. For 160 meters simply by-pass the L net completely and connect the coax between the antenna loading coil and ground. This operates the antenna as a quarter-wave grounded antenna and the loading coil will permit tuning over a wide range from about 1650 kc to about 2200 kc. The SWR will not be over 1.5 to 1 on this band. On this band the quality of the ground system assumes some importance but on the higher bands the ground is relatively not important because the end current is so small that the power loss is practically nil.

One point of discussion remains, namely, the mixed polarization resulting from the fact that both vertical and horizontal portions of the antenna radiate. This may disturb some of the purists but for my part I find it not objectionable. It helps on some close-in contacts where transmission is by the direct ray path, and in cases of ionospheric reflection, both waves come down horizontally polarized in any case.

Comparative Tests

Now, since the ultimate proof is in the performance of the antenna in question, some comparative tests were run and are described below. No serious minded amateur is going to be content with mere impressions collected over a period of time when there are so many variable factors impossible to evaluate. I have in operation a 40 foot vertical that has been giving satisfactory service on frequencies from 3295 kc through 7832.5 kc over a four year period. It was decided to test the horizontal versus the vertical under as near identical conditions as possible. While this does not give an absolute measure of performance, it does give a comparative evaluation. A test was run on an A.F. MARS net on 3295 kc at night and another test was run on a different day net on 7832.5 kc. The test conditions were:

1. The transmitter was first loaded up to a 50 ohm resistive load to determine proper tuning, and thereafter the tuning controls were kept at the loading settings.

2. Each antenna was tuned up with its own coax feeder to show less than 1% reflected power (better than 1.2 to 1 SWR).

3. Each observer set his receiver rf gain at a level to give about half-scale reading on his S meter and did not touch any tuning control or gain during the test.

4. A two minute transmission was made on one antenna while the observers noted the average signal strength on their S meters.

5. The coax feedlines were shifted and a two minute transmission was made with the second antenna.

6. Each station then reported S meter strength for each antenna. *Absolute* S meter readings have little significance since they depend on location, receiver settings, receiver type, etc., but when normalized (i.e. reduced to a common base) they permit a direct comparison of the two antennas under as near identical simultaneous conditions as is possible to create. The significance of this is that since these were *comparative* tests, the same *comparative* performance might reasonably be expected at any location. For the night test on 3295 kc there were 12 stations reporting within a 70 mile radius and 3 stations at 350 miles. All stations reported better signals from the horizontal antenna and were reasonably consistent in an average advantage of 6-12 db in favor of the horizontal. For the daytime test on 7832.5 kc there were 25 reporting stations over a 500 mile radius. Most of them were within a 350 mile radius and their average report was a 12-18 db advantage in favor of the horizontal antenna. Those few stations around 500 miles reported that the two antennas were about equal. One other significant point in both the day and night tests was that nearly all stations remarked that signals from the horizontal antenna were much freer from fading or flutter. Only a few stations in either test were close enough to be receiving a direct signal so this represents nearly all skywave transmission. To avoid any possibility of the "brute force and ignorance" method overcoming antenna performance, these tests were run with a low power transmitter with a plate input of 95 watts. Because there were no operating nets on higher frequencies, no similar comparative tests were possible but the antenna has been operated on both 14 and 21 mc bands, when openings permitted, and the performance has been equally satisfactory.

As you may have surmised by now, this antenna was investigated primarily for the purpose of finding a system that would be completely satisfactory for several widely separated A.F. MARS frequencies as well as for the amateur bands. In this regard it has performed with considerable success, permitting rapid reliable shifts between bands with complete confidence in efficient operation and proper transmitter loading. However, the proven versatility has made it highly attractive for strictly amateur band use.

Credit must be given and acknowledgement is made for the assistance rendered in making the comparative tests by many of the members of the Conac West Coast Central division #2 and the members of the A.F. Western Technical Net. . . .W6AOI

One Tube VOX

Fred Cupp, K8AOE

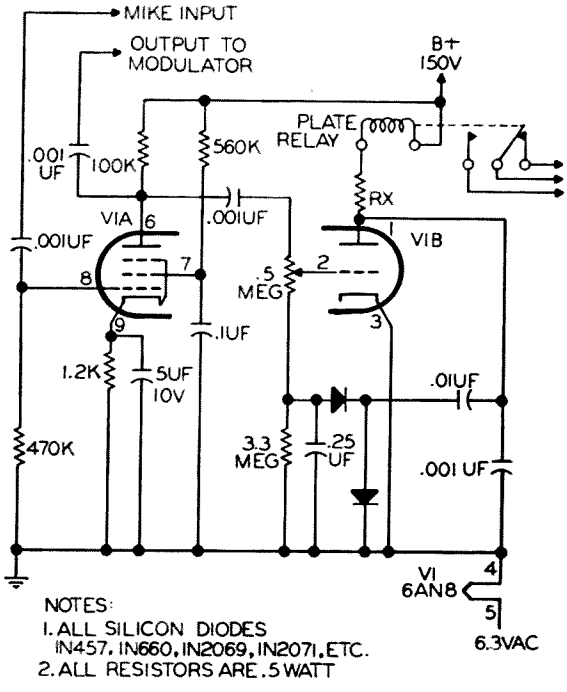
For some obscure reason unknown to this writer, VOX operation seems to be used only by the sideband operators. VOX operation however is very practical for other modes and has been used with excellent results by the author for AM, FM, and MCW on six meters for at least six months. Perhaps the complexity of most VOX circuits drives operators away, so here is a simple yet effective VOX using only one tube which acts as the mike pre-amp as well as the VOX.

The schematic diagram and parts values are shown in Fig. 1. V1a, one half of a 6AN8 is used as a conventional pentode audio pre-amp. The audio signal is coupled from the plate to the gain control and following stages of the modulator. The audio signal is also coupled into the .5 meg VOX Trip Level potentiometer. Audio from this pot is fed into the grid of V1b, the triode section of the 6AN8, and is amplified, appearing across the plate load resistor and relay. The audio is coupled from the plate and then rectified by the silicon diodes and charges the .25 mfd storage capacitor. This negative dc voltage is applied to the grid of V1b through the trip level potentiometer, thus changing the operating point of the triode. This reflex action allows the relay to de-energize thus turning on the transmitter.

This reflex circuit as it is known may be familiar to radio control model enthusiasts, as many R. C. receivers use this principle. The values in this adaptation have been optimized for use as a VOX circuit, however if the builder wishes to have more knobs to twist, the resistor across the storage capacitor may be replaced with a 5 meg. pot. This will allow the operator to set the amount of time delay after he stops speaking.

Any plate relay of greater than 4K ohms resistance may be used in this circuit, and resistor Rx should be selected to give reliable pick-up of the relay with no audio input. With less sensitive relays it may be necessary to eliminate the resistor completely and also raise the plate voltage to get sufficient current. Be sure however to stay within the maximum current ratings of the tube. With a Potter-Brumfield #PW5LS, 10K ohm relay, Rx was 47K ohm. Germanium diodes such as the 1N34 or 1N38 will not work in this circuit as their reverse leakage is excessive. Silicon computer diodes such as the 1N457 or 1N660 are excellent but expensive. A very satisfactory compromise is the power silicon diode types 1N2069 through 1N2071. These have much greater current ratings than necessary but are quite inexpensive and work very well.

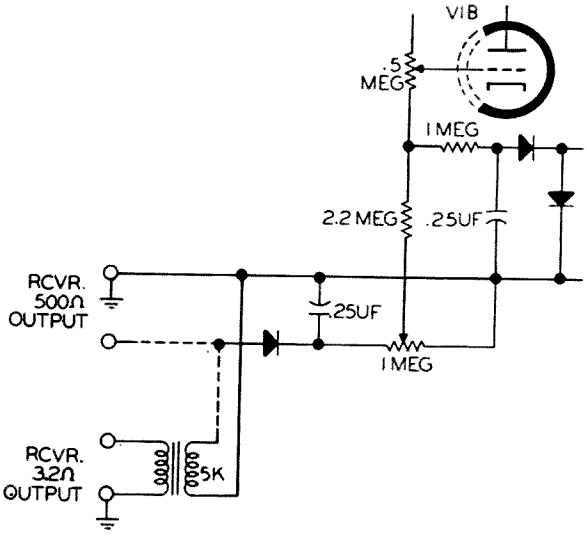
Fig. 2 shows the modifications necessary to add anti-vox to prevent receiver noise



picked up in the mike from tripping the VOX. Audio from the receiver output is rectified positive and bucks the voltage from the VOX rectifier, thus preventing operation of the relay due to receiver noise. If your receiver has a 500 ohm output it may be applied directly to the diode as shown, or a 3.2 ohm speaker output may be stepped up with a small ac-dc radio type output transformer.

As with any VOX controlled station, the operator will have to condition himself to ignore the relays clicking in and out and also avoid the habit of saying, "Ahhh—Ummm—and Uhhh—," in an attempt to keep the station on the air when in reality he has nothing worthwhile to say but won't admit it. Just think how much quieter the band would be if VOX operation was mandatory!

. . . K8AOE



Check Quartz Crystal Activity and Frequency

Adam McLaren WØCGA
213 South 16th St.
St. Joseph, Missouri

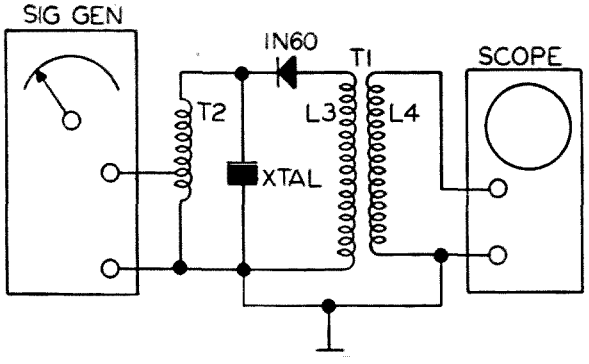
AS solid state electronics is becoming increasingly important in today's equipment it is well to know all we can about testing and using such materials.

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Only a minimum of equipment is needed for preliminary checking activity and fundamental frequency operation. For more extensive mode of operation and higher mode functions a high gain scope is required.

For preliminary checking the circuit of Fig. 1 is used, a pair of headphones is connected across the output of T 2 in place of the scope. The signal generator can be the usual service generator.

A modulated signal is used and the generator is tuned to the approximate supposed fundamental frequency. These frequencies usually will be below 10 megacycles although crystals are made for frequencies higher than this.



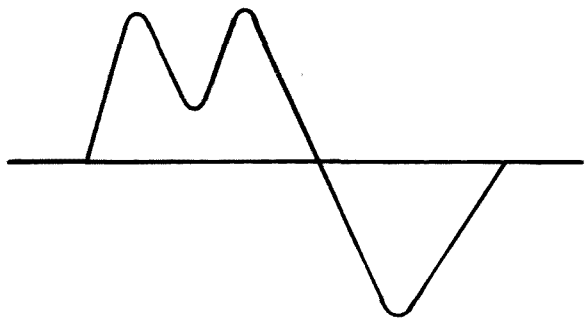
The audio frequency tone from the signal generator will change as the generator signal is tuned across the frequency of the crystal. The tone will also change at the harmonic frequencies of the signal generator but the amplitude will not be as great and drops off rapidly as the harmonic frequency becomes higher. This of course means tuning the generator to frequencies lower than the fundamental of the crystal. All harmonic frequencies of the signal generator will be found in this test and will be exact submultiples of the crystal fundamental frequency. Dividing the fundamental crystal frequency by 2-3-4 and etc. will indicate the fundamental frequency of the signal generator. Thus if a crystal of known accuracy is employed it can be used to calibrate the accuracy of the generator at frequencies lower than the crystal frequency. This of course works both ways and if a generator of known accuracy is used it can be used to accurately indicate the frequency of the crystal. If a high gain scope is used instead of headphones harmonic frequencies of the generator as high as the 10th. will be indicated.

When a crystal oscillates on an overtone it breaks down into layers and oscillates at odd harmonics of the fundamental. Multiplying the fundamental frequency by any odd number indicates the frequency of the higher mode at which the crystal will oscillate. Thus a 3910 kc crystal operating in the 3rd. mode would be 3910 kc multiplied by 3 equals 11,730 kc. Overtones are seldom exact multiples of the fundamental frequency. Ordinary crystals will usually operate very well on the 3rd. mode depending on the type of holder. Crystals ground for higher order mode operation will usually show greater activity at all higher modes.

For indicating higher mode operation of crystals the scope must be used. The indications on the scope show a notch in the sine wave pattern in much the same way as in receiver filter circuits. These points are very sharp and may be passed over if the generator is not tuned slowly.

The activity factor of the crystal is indicated by the depth and sharpness of the notch. A good active crystal will pull the notch down to almost the zero voltage line. Fig. 2 shows the sine wave with the notch shown in the first half cycle of the scope pattern.

To check a crystal of unknown frequency tune the generator over a band of frequencies in which the crystal frequency is suspected to be. If an indication is found note the frequency and if this is the fundamental the next lower frequency of the generator at which an indication will be found will be one half the first frequency noted. Also if this is the fundamental frequency the next higher frequency at which an indication will be noted will be three times the first indication, or the 3rd mode. If this is true other indications will also be found at five or seven times the first frequency. Note that frequencies above the fundamental will never be indicated at 2-4-or 6





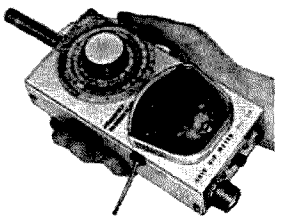
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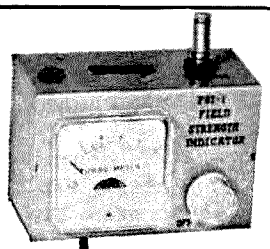
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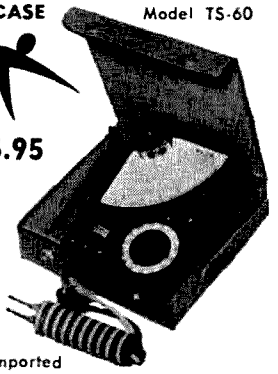
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Dept. 666 — 3 Walcott Ave., Lawrence, Mass.

times the fundamental frequency.

For instance a fundamental frequency of 4 megacycles will have indications also at 12-20-or 28 megacycles. Also below the fundamental frequency, indications will be at 2 megacycles, 1,333.3 kilocycles, 1000 kilocycles and etc.; these being the harmonic frequencies of the generator.

Tuning the generator through the different bands of frequencies going higher in frequency a point will be found where the next higher frequency indication will be 3 times the frequency of the point before mentioned. This last is the 3rd harmonic and the point first referred to is the fundamental frequency. A very slight indication may be found between the fundamental and the 3rd mode frequency. This is due to the 2nd harmonic of the generator exciting the crystal on the 3rd mode and can be ignored.

Also note that if the fundamental frequency is 4 megacycles and the 2 megacycle point had been found first then the next lower frequency indication point will not be 1 megacycle but will be 1,333.3 kc and the next lower frequency indication will be 1 megacycle. This shows that the 2 megacycle point was not the fundamental.

All this is much easier to do than to explain but simply by tuning the generator through the different frequencies watching for the stronger blips and making a few mental calculations as you find the different points it becomes easy to check a crystal in all its modes.

The coil T 2 in Fig. 1 works well at frequencies from 400 kc to 20 megacycles. It was found quite critical and dimensions should be followed closely. . . .WØCGA

Sig. Gen.—Usual service signal generator.
T2—11 turns #20 cotton covered wire, tapped at center on 2.5 inch form.
T1—4 to 1 audio interstage transformer.
L3—Primary.
L4—Secondary.
Scope—High gain.

Letter

Dear Wayne:

It isn't often that I drop people a line voicing my opinion, but a recent article in the February edition of 73 demands response.

I want to express my thanks for printing Paul Barton's article on FINAL TANKS on page 12, etc. This is the kind of technical information that I crave for, and you have made one ham very pleased. Convey my best regards to W6JAT, assuring him that K2SKK has read it all and is putting this to good use. In my estimation, this article was worth the entire year's subscription; anything else you print as good as that will be "ice cream & cake" for me!—For second choice, I enjoyed WA6QFD's article on Silicon Rectifiers, p. 38. Keep up the excellent work!

Bon voyage to you and the XYL on your forthcoming trip to West Germany et al. Drive that Porsche carefully; we want you back to keep 73 going!

100—27!

Paul Boivin, Jr., K2SKK

Before the Breadboard

Staff

IF the response to our articles means anything, we hams are building equipment again; receivers, transmitters, test equipment, station accessories, you name it and chances are that somebody is working on it right this minute.

This is a wonderful situation; we like it! But the average response to a 73 article shows something else, too, which we find a bit disturbing: many of these people who are building gear now have an alarming lack of knowledge about the fundamentals of circuit techniques.

It's not really their fault; just about the only place to get these fundamentals is from an engineer (or material written to be read by an engineer) and all too many professional-type engineers seem to believe that these details cannot be communicated in anything but engineeringese—which leaves us poor hams out in the cold unless we happen to be technical translators.

Naturally, after hearing all the high-level talk about the difficulties of original design, we as neophyte designers begin to get the idea that it's a difficult project; the vicious circle is complete, and we stay in our somewhat befuddled state, believing that the art of original design is far too complicated for us.

"T'ain't necessarily so," in the words of the song. Sure, original design of a completely reliable communications system capable of handling 512 independent messages at the same time, on the Earth-Moon-Earth circuit, may be a bit beyond our capabilities. But not *all* design work is difficult; most of it is simpler than you think.

And if you think that any sort of understanding of the basics of circuit design are beyond you, take a look at Fig. 1.

Simple, isn't it? Just three resistors in series. But let's look at this circuit a bit, and study it.

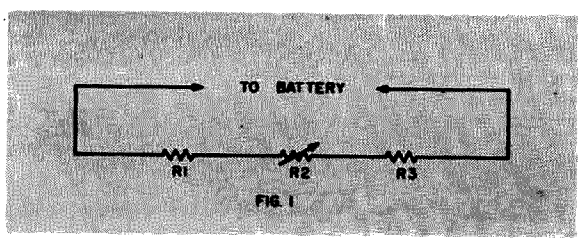


Fig. 1 Class A Circuit.

Since the three resistors *are* in series, all the current which passes through any one of them must pass through the other two. Since there are no other components in the circuit, the total voltage drop across the entire string must be equal to the total voltage applied to the circuit; there's no place else for it to go.

That's simple enough, isn't it? Yet the two sentences of the preceding paragraph state the two fundamental laws of network theory (usually considered the exclusive domain of the BSEE). "All the current that flows into a series junction between two circuit elements must flow on out" is the current law, while "the sum of the voltage drops across circuit elements in series is equal to the applied voltage" expresses the voltage law.

All very interesting, you may say, but what earthly good are three resistors in series to me in the design of a circuit? Let's take another look.

Suppose that the center resistor of the string were a variable resistor instead of having a definite fixed value. Suppose, also, that a constant-voltage battery were hooked up across the entire string. Finally, suppose that R1's resistance were considerably lower than that of either R2 or R3, and that the values of R2 and R3 were approximately equal. Now, let's examine the voltage acoss R3.

With R2 set for maximum resistance, the voltage across R3 would be just less than half that of the battery. Resistor R1, with its low value, would drop some of the supply voltage, but most of it would be divided equally between the two larger resistors.

If R2 were set for minimum resistance, on the other hand, the voltage across R3 would be almost equal to the battery voltage.

Now let's suppose that we have a trained Mongolian Midget operating R2; our Midget cranks the value of R2 up or down instantaneously according to prearranged signals we give him. The voltage across R3, naturally, varies in perfect step.

If the signals we send our Midget are very small voltages, and if the battery voltage is very large, the voltage across R3 will also be large—and you might say we have an amplifier.

This amplifier, of course, depends for its operation on a very special kind of Mongolian Midget—you might say, a Mythical Midget.

Except that he isn't mythical at all; you can purchase him outright for less than a buck anywhere. What's more, he comes complete with variable resistor. Our Mythical-Midget-resistor combination is nothing more nor less than the conventional electron tube; the cathode-to-plate resistance is the variable resistor, while the grid is the midget.

In the electron tube (and also in the transistor), the operating technique is exactly the same as our three-resistor circuit of Fig. 1. The tube itself corresponds to resistor R2; R1 represents the internal resistance of the power supply (this is what makes the voltage drop as you increase the load; the smaller it is, the better); and R3 is the load resistor.

You can see from the three-resistor circuit that the output voltage available is directly dependent on the value of R3; the larger R3 is, the larger the output voltage will be. In no case, though, can output voltage swing farther than the original supply voltage (except in the case of inductive coupling, which is a bit complicated for this stage of the game).

Electron-tube circuits work the same way, with one important addition: since a certain amount of current is required by the tube, R3 cannot be too large. If R3 is made too large, the tube will be starved and will fail to operate properly. But within this limit—and it's wide—the gain will go up directly as the load resistance is increased.

If, at this point, you're thinking it can't possibly be this simple, you're only half right. Actually, you can make almost any tube do almost anything you want with no more information than that already given—but that's doing it the hard way, and may prove to be a bit costly if it takes you five or six burned-out tubes to find out just what values are permissible for R3.

To avoid this problem, manufacturers make available "characteristic curves" for their tubes. Every tube has a number of unique characteristics, mostly determined by the spacing and type of grid structures inside the tube. Any or all of these characteristics may be measured, and the results presented either as tables or as graphs in which key characteristics are presented together.

The most common means of presenting these characteristics is graphically, using what is known as the "plate family" of curves in which plate current is plotted against plate voltage, for certain fixed values of screen and control-grid voltage. Such a curve, for a type 12AU7 triode, is shown in Fig. 2.

From this graph (commonly known simply as the tube curve), you can determine the value of the tube's resistance (R2 in Fig. 1) in ohms by applying Ohm's law to the values of voltage and current which intersect at a

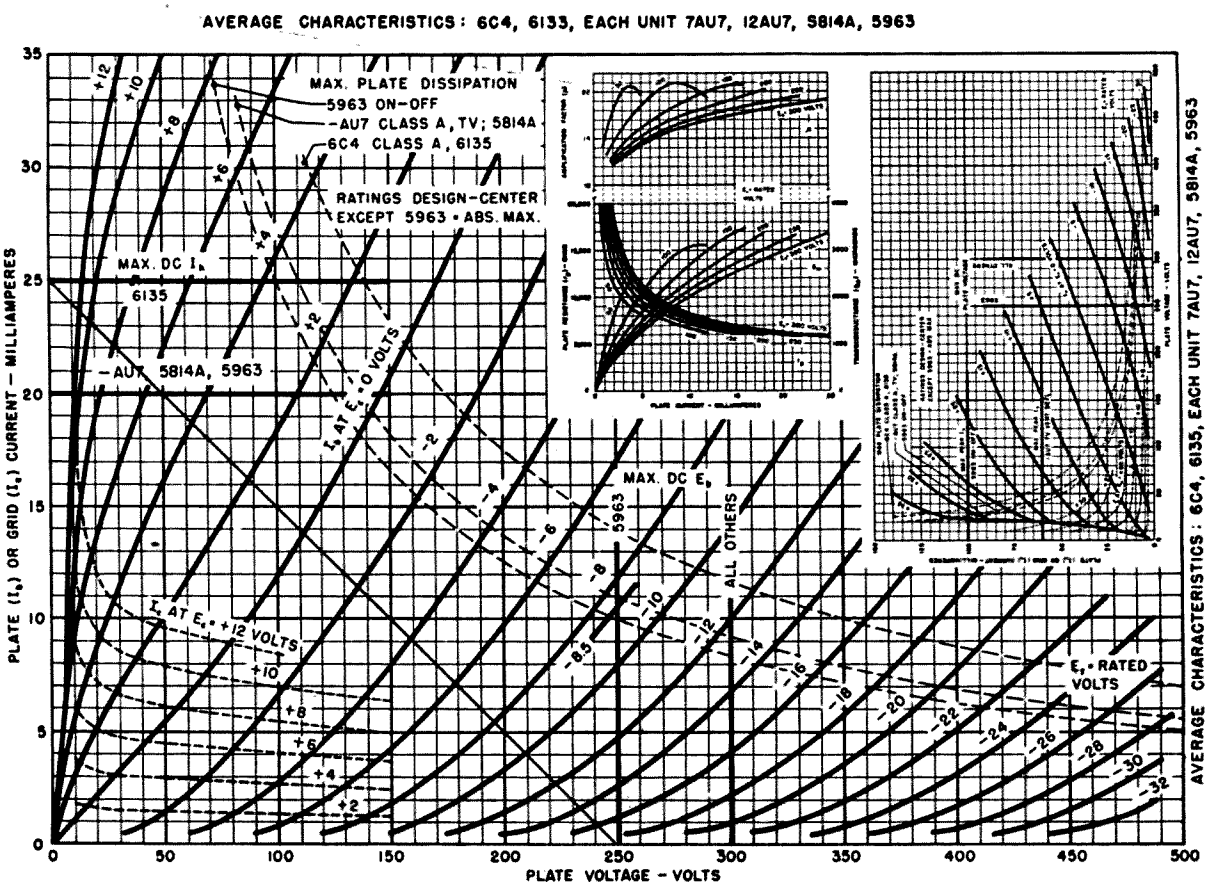


Fig. 2 Typical Plate-Family Characteristic Curves for 12AU7. Sample Load Line (10,000 ohm resistor

given grid voltage. For instance, if plate voltage is 150 and grid voltage is —2, the curve tells us that plate current will be 13.5 ma. Since resistance is equal to voltage divided by current, the resistance equivalent to R2 would be 150 volts divided by 0.0135 amperes, or 11,100 ohms.

It would be possible to use this procedure to determine the values of R2 over a wide range of voltages, then choose a fixed value for R3, and come up with an amplifier circuit —but such a set of calculations would be tedious. Since all the information we need about the tube is already shown in graphical form on the characteristic chart, it only makes sense to continue the design by graphic methods. This approach almost completely eliminates arithmetic, and rapidly produces a design.

The heart of the graphical design procedure is an item called a "load line." This is simply a straight line drawn on the chart through all the positions whose voltage-current relations come out to the value of R3, the load resistor.

Note that we said it goes through "all" the positions; however, you don't have to calculate them all. Since the resistance is fixed, the line will be straight—and this means that only two points need be calculated. Two points which are exceptionally convenient to calculate are those at which voltage equals zero, and at which current equals zero. If you know the value of supply voltage, this means that only one calculation is necessary; when current equals zero, voltage will equal that of the supply, but when voltage equals zero, current will equal the supply voltage divided by the value of R3.

To put this procedure into step-by-step form, first choose the tube you're going to use and obtain a chart for this tube type. Next, pick the supply voltage. Third, select a trial value for the load resistor (remember that the higher the value of the resistor, the greater the gain). Fourth, draw a dot at the point where the voltage line corresponding to the supply voltage intersects the zero-current line. Fifth, calculate the value of current when voltage is equal to zero, and place a second dot where this value of current intersects the zero-voltage line. Finally, using a ruler or straightedge, draw a line connecting the two dots.

What do you have, now? Basically, you have plotted the possible operating points of the tube. Let's do an example before discussing how it works. Since we have already used the 12AU7 curve, let's use it again. Pick a supply voltage of 250, and a trial load resistor of 10,000 ohms. The value of current at zero voltage will then be 250/10,000 ampere, or 25 ma, and we draw the load line connecting 25 ma at 0 volts with 0 ma at 250 volts as shown in Fig. 2.

Now, looking at Fig. 2, let's see how this works. Assume that the grid voltage is zero. The tube (if R3 were not in the circuit) would try to draw a large amount of current—but the load line shows us how R3 limits the current in the series circuit, and the operating point for the tube and R3 together is thus the intersection between the 0-volt grid bias curve and the load line itself, or a plate voltage of 110 volts and a current of just under 14 ma.

Since most amplifiers don't work right when the grid voltage goes positive, it's usual practice to bias the grid negatively so that incoming signals (which alternate on either side of zero) won't drive the grid positive, ever. Let's see what happens when we put 2 volts negative bias on our circuit.

The first thing we see is that our operating point has shifted. It's now fixed by the intersection of the load line and the —2 volt bias curve, at a plate voltage of 135 volts and a plate current of 11.5 ma. This means that, going back to the simple circuit of Fig. 1, 11.5 ma is flowing through the entire circuit. This current through the 10,000 ohms of R3 develops a voltage drop of 115 volts, leaving 135 for the tube itself—which checks with our earlier figures (we omit the voltage drop in R1 as negligible—and hope that it really is).

Now, let's put a 4-volt peak-to-peak signal in at the grid of the amplifier we're designing. On the positive half-cycle, this input signal will reduce the grid bias to 0; plate voltage will swing down to 110 volts as the current through the tube increases. On the negative half-cycle, grid bias is increased to —4 volts. The load line tells us that plate voltage at this point is 160 volts, with a current of 9 ma.

Thus, the 4-volt input signal has resulted in a change of output voltage between the limits 110 to 160 volts, or a 50-volt output swing. To determine the gain, divide the output voltage swing by that of the input voltage—in this case, it's 12.5.

So far, we've examined only the gain; the amplifier may produce plenty of gain yet not be usable because of distortion. We'll go into that in more detail before long, but at this stage you can make a rapid check by comparing the gain on positive half-cycles with that on negative half-cycles.

If these two half-cycle gain figures are the same, the chances are the amplifier's distortion will be low.

In our example, the positive half-cycle gain was 12.5, corresponding to an output-voltage swing from 135 to 110 for a 2-volt input change. The negative half-cycle gain, also, was 12.5 (swing from 135 to 160 for similar 2-volt input). Distortion probably will be low.

This load-line technique is valuable in the design of audio amplifiers; it works just as well for low-level amplifiers and for high-power modulators. You can even make it work for push-pull circuits, but those are a bit beyond the scope of this article.

Naturally, this is not the only approach to amplifier design—just the simplest. The graph-

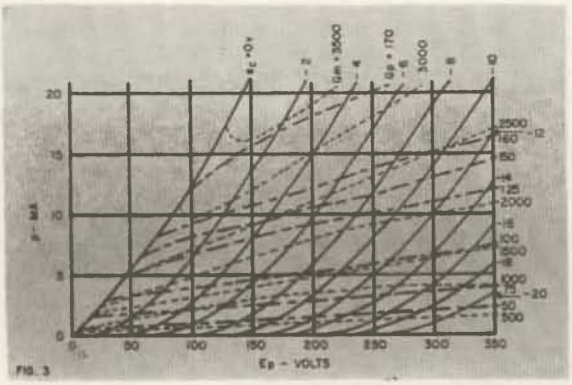


Fig. 3 G-Curves for 12AU7.

ical technique eliminates all algebra and higher mathematics usually associated with circuit design. However, if you feel that it's *too* simple this way, you can use the standard gain formulae and techniques to be found in Eastman's book (or almost any other handbook). A completely different approach, which includes many practical effects ignored in the conventional design technique, is to be found in Pullen. Pullen's technique, for instance, is the only one commonly available which allows for the effects of cathode resistors, loading of the next stage, and variations between tubes of the same type—but it *does* require algebra and the ability to plot your own tube curves, since he uses "G-curves" which manufacturers don't furnish. A G-curve for the 12AU7, which may be compared to the conventional curve, is shown in Fig. 3. Don't let it scare you.

A few paragraphs back, we promised some more words on distortion. Here they are.

The cause of distortion in an amplifier is simple: the gain of the stage changes as the input signal varies. If the change in gain is small, the distortion is unnoticeable; if the change is large, the distortion becomes obvious.

To calculate the precise amount of distortion produced in a stage, we have to know the precise amplification at the positive and negative peaks of the input signal—and this in turn requires the exact techniques of either Pullen's procedure or the conventional mathematical approach.

However, for our purposes we can do quite well by comparing the average gain on positive half-cycles with the average for negative half-cycles; that's what we did earlier. If these gains are the same, distortion will be negligible. If they differ (positive peak gain will be higher), distortion will appear.

To determine how much distortion to expect, subtract the lower gain from the higher one and record the difference. Then add the two gains together, and divide the difference you just noted down by their sum. Multiply the quotient thus obtained by 25, and the result will be the approximate amount of 2nd-harmonic distortion, in percent, which will be produced.

Naturally, harmonic distortion includes more than just 2nd harmonic. However, 2nd-harmonic distortion appears first and becomes objectionable long before the other components are large enough to calculate by this process, so if it's a reasonably small amount, the other components can be ignored.

So far, we've talked only about audio amplifiers. The same principles apply to RF and IF amplifiers in receivers, except that two load lines must usually be plotted for these.

The reason for two load lines instead of one is that the stages of such amplifiers are usually coupled by transformers or chokes, instead of by resistors; this means that the DC supply to the plate sees little resistance, while the AC component of the plate current (which is the desired output signal) sees quite a large "resistance" which forces it to go to the next stage.

To plot these dual load lines, draw a *vertical* line at the supply voltage for the DC load line; this shows that the tube's current is controlled only by the grid voltage. For the AC load line, a bit of figuring is necessary.

First, calculate the amount of current increase which would be produced by a 100-volt increase of voltage through the "resistance" (AC value) of the coil concerned. If the resistance is, say, 100,000 ohms, the current change would be 100 volts divided by 100,000 ohms or 1 ma.

Now, put your pencil at the point where the DC load line crosses the selected grid-bias value. This is the operating point. Measure off 100 volts *toward zero* (an increase in voltage across the load resistance is a *decrease* in voltage to the tube) from this point, and then measure up 1 milliampere (the calculated value) from the current at the operating point. Draw a line from this point you just located, through the operating point, and extending to zero plate voltage and to twice the DC supply voltage. This line is the AC load line; gain can then be found from it by employing the following variation of the procedure already described:

As in the single-load-line procedure, assume an input signal of the largest value you intend to handle. Follow the grid-bias curve corresponding to the resting bias plus the positive-peak value of input signal until it intersects the AC load line. Drop down to the plate voltage scale to determine plate voltage at this point.

Now, follow the grid-bias curve corresponding to the resting bias plus the negative-peak value of input signal until this curve also intersects the AC load line. This intersection point will be to the right of the DC load line; drop down to the plate voltage scale to determine the plate voltage for this point.

Don't let the fact that the negative-peak-signal plate voltage value is *larger* than the voltage supplied to the stage scare you; this

is natural, since the coil in the plate circuit stores up energy while current flows, so that a signal which reduces current flow releases the stored energy. This stored energy then appears at the plate of the tube as excess voltage, above the plate-supply value.

Once you have found the positive-peak and negative-peak plate voltage values, you can calculate the gain by dividing the swing by the peak-to-peak value of the input signal, just as for the resistive amplifer discussed before.

Not yet mentioned has been the problem of designing Class C amplifiers for transmitters; they are put together in a completely different manner. However, space has run out for this month, so we'll have to postpone that until a later technical article. Until then, keep in mind the three simple resistors—they're the heart of every circuit-design problem!

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Transistorized Modulator

Burt Yellin K2STV

Being like many other hams, I have often sought an efficient, compact, universal modulator. Although only 75% modulation is obtainable through the use of this circuit, it is efficient in that it requires a minute amount of power. Battery current is in the order of microamps, therefore allowing the battery to last its entire shelf life.

The modulator shown in Fig. 1 is capable of cathode modulating any transmitter up to the full power input of one kilowatt. In many instances the transmitter will not have to be modified. If the transmitter uses cathode keying, all you do is simply plug the modulator in, instead of the key.

The circuit uses four NPN transitors compound connected. Compound connected transistors have the following characteristics: a high input impedance, and an extremely high current gain. This is perfect for cathode modulation, as a crystal mike can be used, and the circuit will control the cathode current of the power amplifier in the transmitter. The circuit has one other advantage, and that is that it will act as a clamp tube. Should the final lose drive, the modulator will limit the amount of cathode current, which is determined by the setting of R_1.

Any NPN transistors can be used for Q_1, Q_2, and Q_3 providing their beta is 30 or greater. Q_4 must be chosen by the amount of cathode current that will be flowing through it.

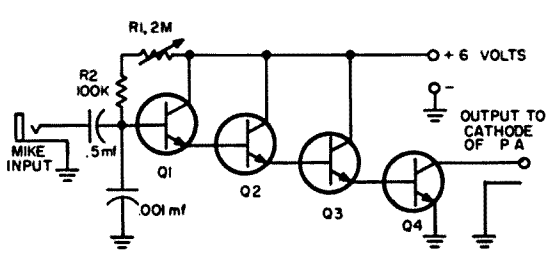


FIG. 1

To use the circuit, tune your transmitter as is normally done for CW operation, insert the modulator, and adjust R_1 until you get the maximum change in cathode current with speech input.

. . . K2STV

TAPE TIP

An ever increasing number of "do-it-yourself" decorative and finish materials are reaching the market. One item that should be attractive to the amateur constructor is an adhesive backed, metal tape that is available in several patterns.

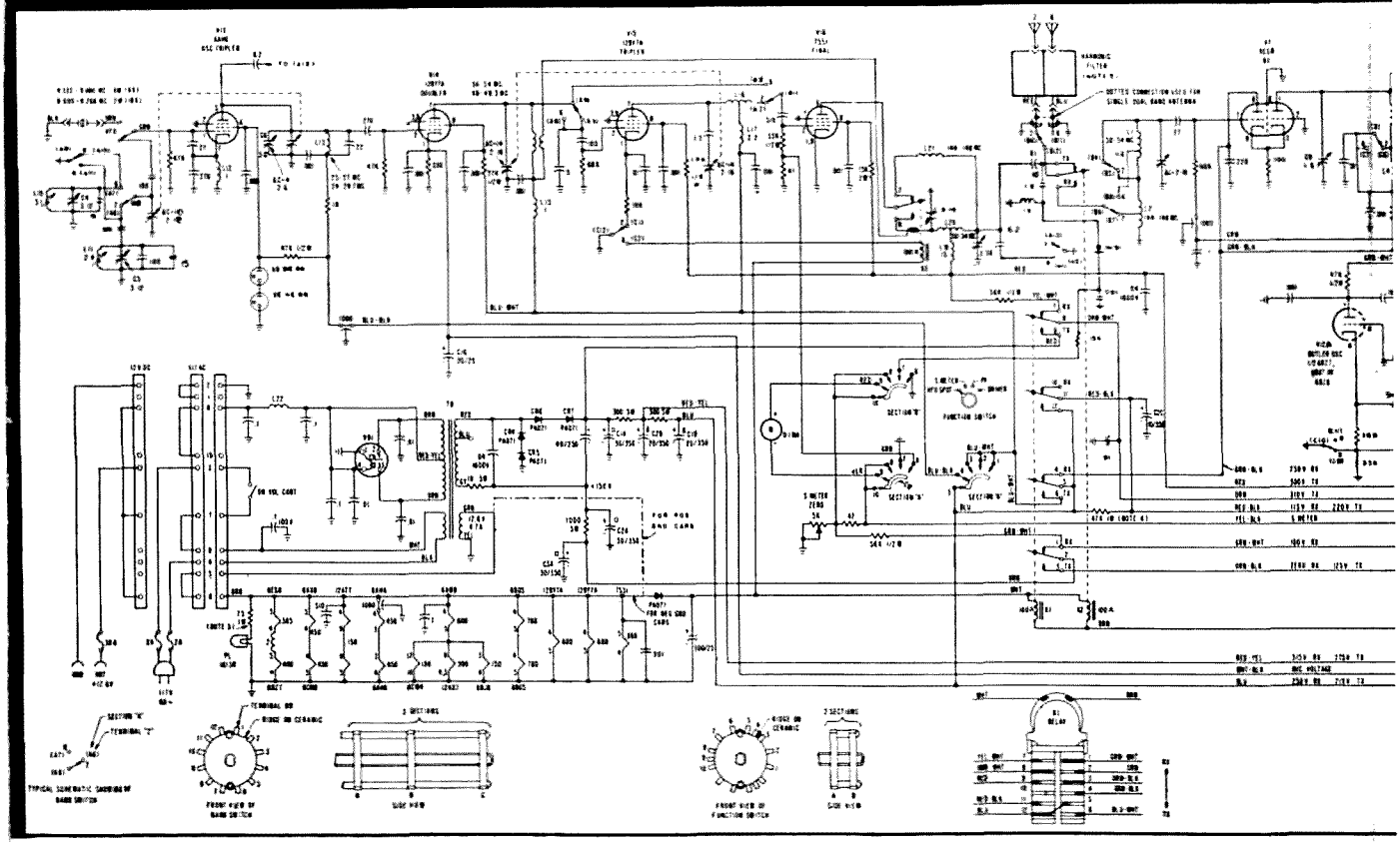
This tape and one application are shown in the photograph. While the tape may be used for strictly decorative purposes, it is convenient for covering equipment finish imperfections and unused holes. Application is a snap. Simply cut the strip to size with a pair of shears, peel off the adhesive protector paper and apply to any clean, dry surface.

The particular product shown in the photograph is a metalized, Mylar tape, sold under the Trimbrite label. The manufacturer is Marglo, Inc., New Britain, Conn. and the tape is available in most hardware stores.

. . . W4WKM

Photograph by: Morgan S. Gassman, Jr.





And In Spite of IT ALL;

Receiver: (triple conversion superheterodyne)

Frequency Range: 49.750 to 54.250 MC and 143.750 — 148.250 MC. (Includes C. A. P. Frequency.)

Calibration: 100KC graduations every 4°.

Tuning Ratio: 6:1.

Sensitivity: Better than .2 uv on 6 meters and better than .8 uv on 2 meters for 6 db s + n @ 30% @ 1000 cps modulation.

Selectivity: —6 db bandwidth 8 KC ± 2 KC.
—60 db bandwidth 25 KC ± 5 KC.

AGC: Audio output varies less than 3 db from 1 uv to .1 volt.

Delayed AGC: Knee of AGC occurs between 3 and 10 uv.

Squelch (adjustable): At threshold receiver will awaken for carriers of .08 uv or greater on 6M and will awaken for carriers of .1 uv or greater on 2M. At stop receiver will awaken for carriers of 10 uv or greater. (Stop limit adjustable from 3 to 30 uv).

Noise Limiter: Floating series gate type operates on all noise peaks. Audio unaffected by modulation levels less than 85%.

Audio Output: At least 2.0 watts into 2½" PM internal speaker or at least 3.0 watts into external 4 ohm speaker. Provisions for 5W into external speaker.

Distortion: Less than 15% from 250 to 3000 cps at 1 watt output.

Hum and Noise: Better than 40 db down from 1 watt output.

Freq. Response: Within + 1 db to — 5 db from 250 to 3000 cps (reference 0 db at 1000 cps at 30% at 100 uv).

1st Image: Better than 85 db down on 2M. Better than 40 db down on 6M.

2nd Image: Better than 60 db down.

3rd Image: Better than 85 db down.

Spurious Responses: Better than 50 db down everywhere except within ± 20 KC of desired signal.

Internal Generated Spurious Signals 145.17 approx. 90 uv (S9) 147.80

Cross Mod and Desensitization: Better t
± 20KC.

IF Frequencies: 52.00 MC (± 2 MC)
5.405 MC 455 KC

Compliance: Meets FCC Rules Part
Radiation Device.

Stability: Less than ± 15KC During 4
Less than ± 2KC/HR thereafter.

Transmitter (separate osc, multiplier through final amplifier)

Plate power input to final: 18w 6M 17w

RF Power Output: At least 9.0 watts ou
At least 4.0 watts ou

Mod. Cap.: 85 to 100% at average spea
modulation.

Hum and noise on carrier: at least 40 d
modulation level.

Harmonic Suppression: All harmonics
sions better than 50 db down. Excee
quirements.

Microphone (all press-to-talk): unit norr
grey plastic high impedance detacha
phone with 5' retractable coil cord.
hardware.

Frequency Control: VFO or crystal.

Crystal Stability: ± .005% —30° C. to

Crystal Circuit Stability: ± .006% —

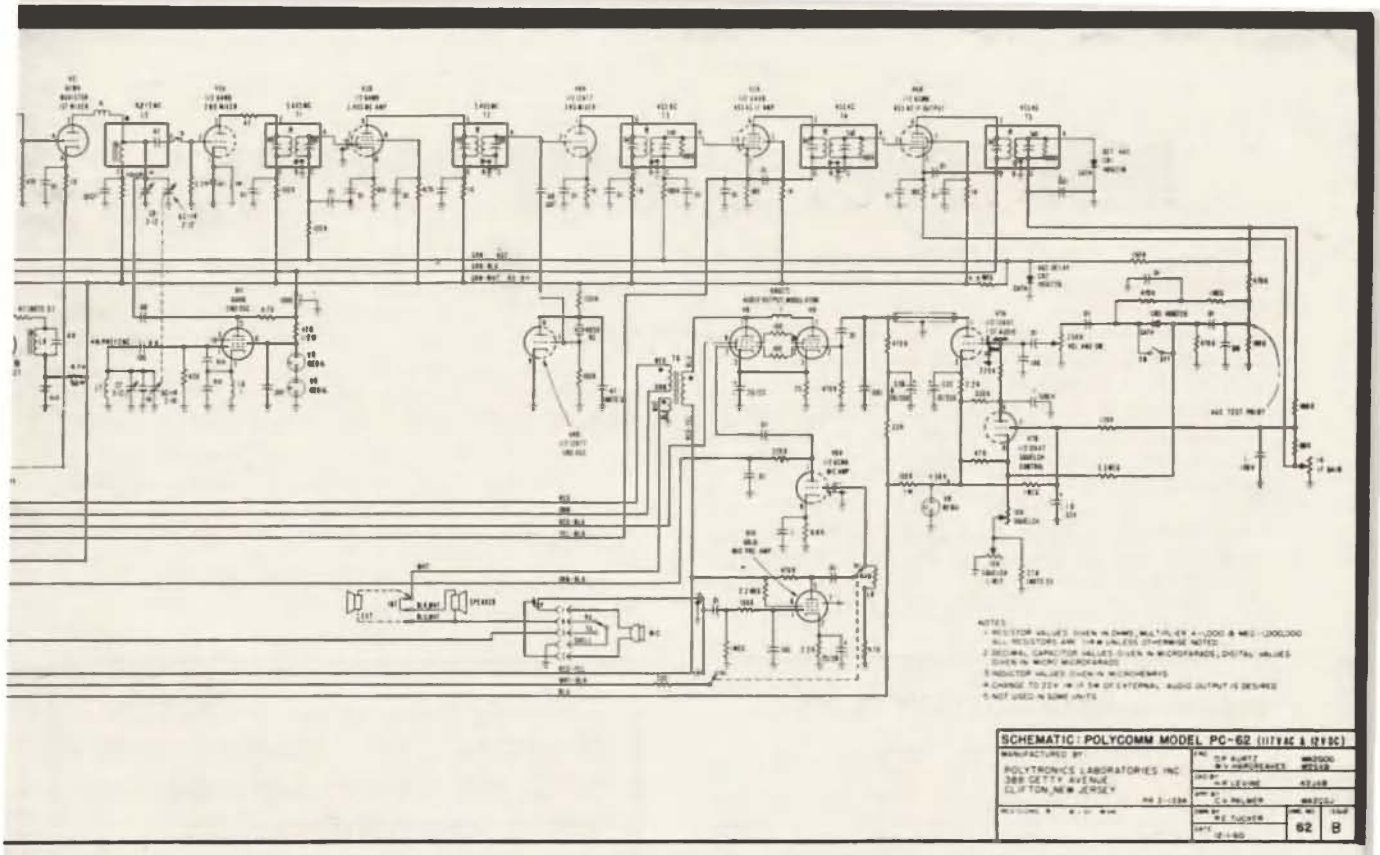
VFO Stability: Less than ± 25KC on
40 minute warm up. Less than ± 6

Humidity: Will perform after being su
95% relative humidity for 8 hours.

Vibration: Will withstand 10G shake fro
for 30 minutes in three planes.

Shock: Will withstand 15G shock in thre

Supply Voltage Variation: — 20 to +
voltage.



rox. 80 uv (S8)
50 db down at

re: Incidental

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l.
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lown from 30%

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- 70°C.
C. to + 60°C.
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/HR thereafter.
ted to 90°C. at

60 to 1800 cps.

lanes.
of rated input

AC Power Consumption: 90 watts receive, 140 trans.
DC Current: 10 Amps rec. 16 Amps trans. @ 12.6 volts.
Size: 11" wide x 10" deep x 5" high.
Weight: 15 lbs. total system weight.
Color: Marine grey, maroon knobs, white lettering, brushed aluminum grill.
Shipping Weight: 23 lbs.

The PC 62B is a COMPLETE 2 band mobile/base station ready to operate. Well almost, need an Antenna? Turn →





Amateur Net

379.50

INCLUDES, replaceable microphone with hang-up clip, universal mounting bracket for mobile operation, AC and DC cords, separate antenna connectors (SO 239) and all mounting hardware.

HOW ABOUT QUALITY CONTROL?

Frequently Hams have the impression that electronic equipment is simply built and then shipped. Nothing could be further from the truth. Inspection, alignment, operation, testing and quality control assurance consume most of the time required to produce a unit.

Polytronics is very proud of the fact that all its technicians are very active Hams well acquainted with the performance desired and required by VHF enthusiasts. The PC-62 was designed by WA2GOG and W2SXB. The President of Polytronics is K2JXB. All power supplies are checked out by Hal, K2SGX, the Tx section specialist is Steve Fancher, WA2ZNE. Shade M. Lee, WA2OJB aligns the receivers, while Pearl (Tiger) Maguire, WA2QNY, tracks the VFO. After all this, Joe, K2QLW, (Quality Control) gets a chance to reject any unit not up to his high standards.

In the event of trouble, thereafter, our service manager, Frank Siggins, WA2TDD, can expertly diagnose and correct any problems.

Every PC-62 is supplied with an Individual Test Data Sheet, which contains an actual record of the performance of the unit during test and is attested to by the signatures of each of the above.

Personalized performance? You bet. Drop in and meet the gang.

NOW — ABOUT THAT VFO . . .

. . The VFO used in the PC62B is not a substitute for a crystal nor can it be compared to a single tube external VFO. Our specs call for a drift of no greater than ± 25 KC on either band during a warm up period of 40 minutes, thereafter the VFO will remain within the pass band of any good 6KC wide receiver.

Our VFO is intended as an aid in obtaining contacts during skip, field days, or break-breaking; it is not a secondary frequency standard, but it is a darn good VHF HAM TYPE VFO.

Our Antennas are UNCONDITIONALLY GUARANTEED NOT TO DRIFT! See, we can make something stable.

Antennas :**PCA-251:** Whip only. 2 & 6 meter dual band antenna. Standing wave ratio of 1.1 to 1 at resonance and no greater than 1.5 to 1 at any point in the band. **$13.95.**

PCA-249: Same as above with cowl mounting. Complete with 15 ft. RG-58/u cable and PL/259 connectors at both ends. **$21.95.**

PCA-250: Same as above with standard stud, ball mount, cable and connectors. **$23.95.**

The PC62 CD (also $379.50) has been approved as meeting specification CD I-100 in connection with any bids to State and Local subdivision requiring its use for Civil Defense.

OCD Item No's, T-34/R-04, T-36/R-06, M-48, & M-50

OK YOU GUYS:

I DON'T CARE IF YOUR VFO DOES TAKE A HALF HR. TO WARM UP. I WANT A PC 62B ! !

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AGC for the Swan Transceiver

Lawrence Frazier K6SHC

THE Swan 100 series transceivers have caught the eye of many hams, both for mobile and fixed use. These transceivers are sensitive and have a good punching signal on the air.

In talking with many of the fellows who have these transceivers, the one slight improvement desired was an AGC system. When in a round-table with several stations, some are bound to be much louder than others. This requires one hand on the gain control, or a good set of nerves.

The AGC board will be very easy to construct and can be built from parts in the average junk box. The audio choke CH1 can be made from the high impedance (plate) winding of a small audio output transformer. The diode should have a peak inverse rating of at least 300 volts. The current rating need be only a few milliamps, as the current is very low. Good back resistance is very important to keep the positive level set voltage from loading the circuit.

In working with the mounting problem, it was decided to mount the AGC parts all on one board and then mount the board on the side of the metal cover which covers the 5.5 mc crystal filter. Care should be taken in placing the screw holes so that the screws will not touch the crystals or the coil in the center. The wires which go below the chassis can be put through the rubber grommet through which the wires to the relay already go. Small wire should be used so that they will all fit through the grommet easily.

Connection of the AGC to the transceiver should be done as follows: With the AGC wired, tested, and mounted, there should be five wires (including the ground wire) which should go through the grommet to the underside of the chassis. Connect the wire from terminal (1) to the plate of the audio output tube (6AQ5 pin 5). Connect the wire from terminal (2) to the plus 150 volts on the OA2 pin (1, 5). Locate the 1 meg resistor connected to pin (1) of the 1st RF amplifier (6BA6). Remove the end of this resistor which goes to the terminal lug with the rf choke also connected to it. Connect the wire from terminal (4) to the loose end of the resistor just removed. Insulated sleeving should be used to protect against shorts. Connect the wire from terminal (5) to the terminal lug from which the 1 meg resistor was removed. The last wire, from terminal (3) should be connected to a convenient ground terminal on one of the tube sockets.

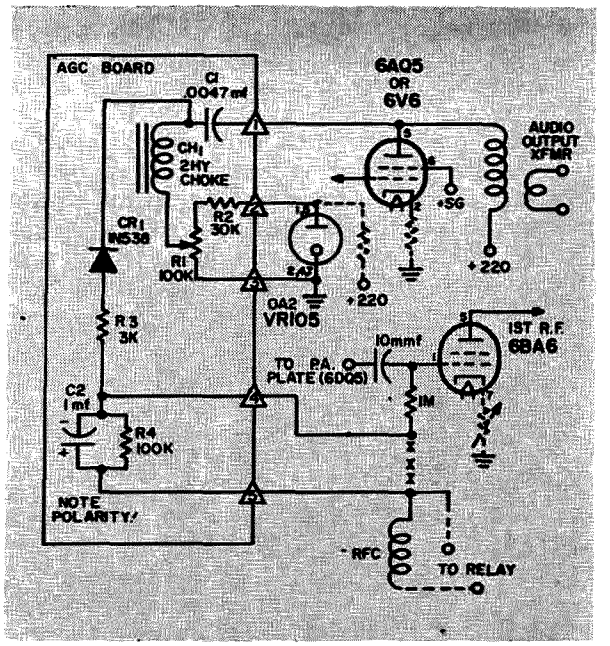
The only control is the level set potentiometer R1 which is used to set the relative level of the clamping action. After this level set has been adjusted for the particular rig, it will not require any further adjustment. Therefore, it can be placed inside the rig out of sight. After the AGC has been installed and checked out, it may be desirable to change the recovery delay time slightly. In order to make the receiver recover faster after a loud signal goes off, the value of R4 should be decreased, but by no more than 40K. To make the receiver recover slower, thereby making quieter operation, the value of R4 should be increased. The value of 100K seems to hit a happy medium.

This AGC is in use in several units and functions quite well. There is little or no attenuation of the weak signals, and the loud signals are clamped to a comfortable level. The gain control on the front panel still functions to control the gain and relative audio output level. Some checks were made, using a sharp cut-off tube (6AK5) in the input stage, and it seemed to produce a more pronounced clamping action.

This circuit has been tried in other receivers with very good results. The best clamping action seems to be with a high gain, sharp cut-off tube in the front end.

With this AGC in your Swan, there will be no more need to keep one hand on the volume control when in a round-table, or while signals fade in and out while driving down the road.

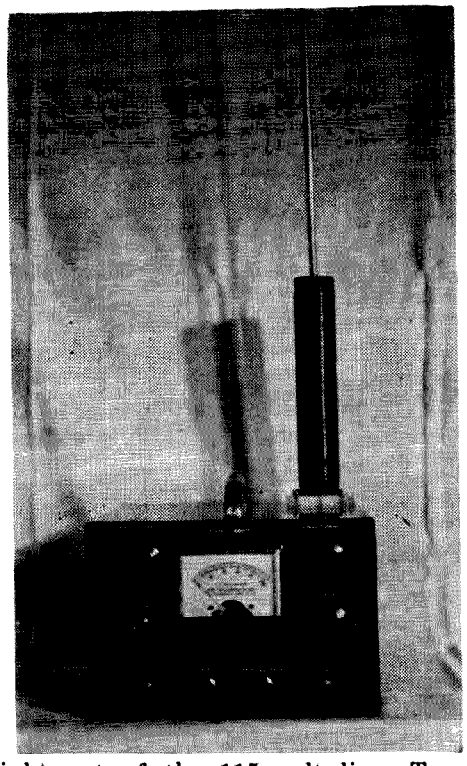
. . . K6SHC



Note: The audio output tube may be a 6V6, in which case the proper pin changes should be made. Also in later models, the type relay has been changed so that there is no grommet by the relay. In this case, the wires to the under side will have to go through one of the other grommets.

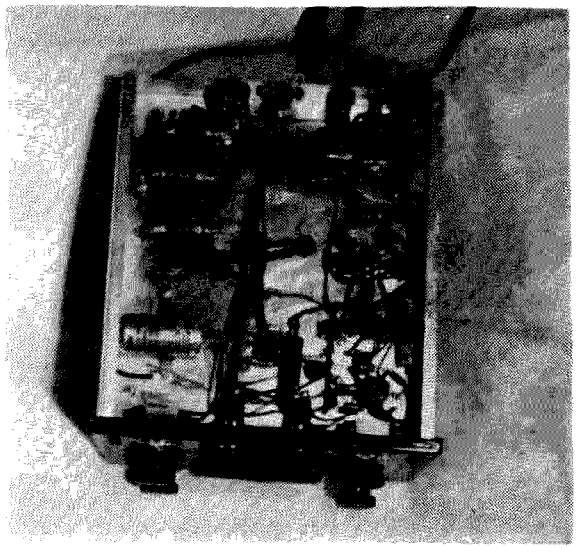
160 Meter Mickey Mouse

C. L. Martin K9PAL
Instrument & Electronic Tech.
General Electric Company
Bloomington, Illinois



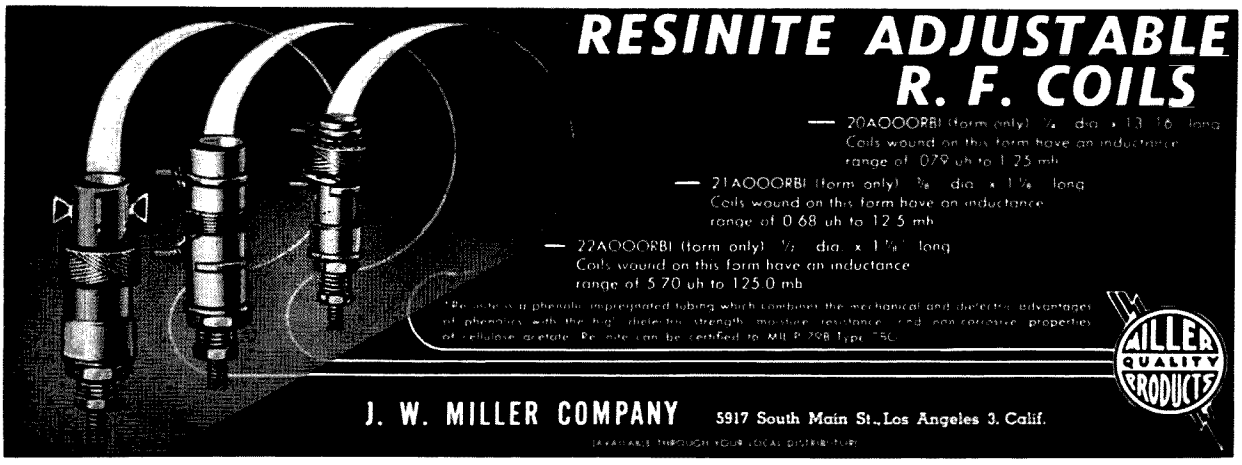
WITH the increased amount of activity on the amateur bands these days, it becomes even more difficult to find the frequency space to carry on the famous "rag chew" session with the local brothers of the profession without "tromping" on some poor soul in the next state who is trying to stretch some range out of the "Half Quart" rig, or move that piece of traffic thru the QRM. Faced with these problems, it becomes even more sensible to make use of that 25 kilocycle hunk of frequency in the 160 meter band for the "local" activity. Range of 25 miles or so is consistent on these frequencies with occasional real DX reported on quite low power. So, to this I add the question "Why not a rig that is portable enough to carry to the over night fishing hole or on the vacation"? The rig described here, combined with a "tuned over" AC/DC set or, small portable provides this portability as well as reasonable power on a vertical or half of the old 75 meter dipole.

Circuit and construction is along conventional lines with the exception of the power supply, which is less common. Here the circuit makes use of a pair of the modern silicon rectifiers in a half wave doubler circuit running straight out of the 115 volt line. Two things are accomplished by this. First the familiar power transformer is absent (a sizeable cost reduction) and second, the ac ground system is used to advantage with the portable whip. To do this without making the cabinet "hot," a built in line polarity indicator is used. With the power switch OFF and the chassis connected to the line "hot" side, the neon will provide enough glow thru leakage to be seen, even if no ground is present on the cabinet. If the neon glows, the line plug need only be turned ½ turn to correctly polarize. A 2 amp fuse in the ground side provides protection in case of a mistake in polarity when the rig is attached to an earth ground. Such a system is not dangerous when handled properly. It is strongly advised that an earth ground be attached to the cabinet whenever possible, however.



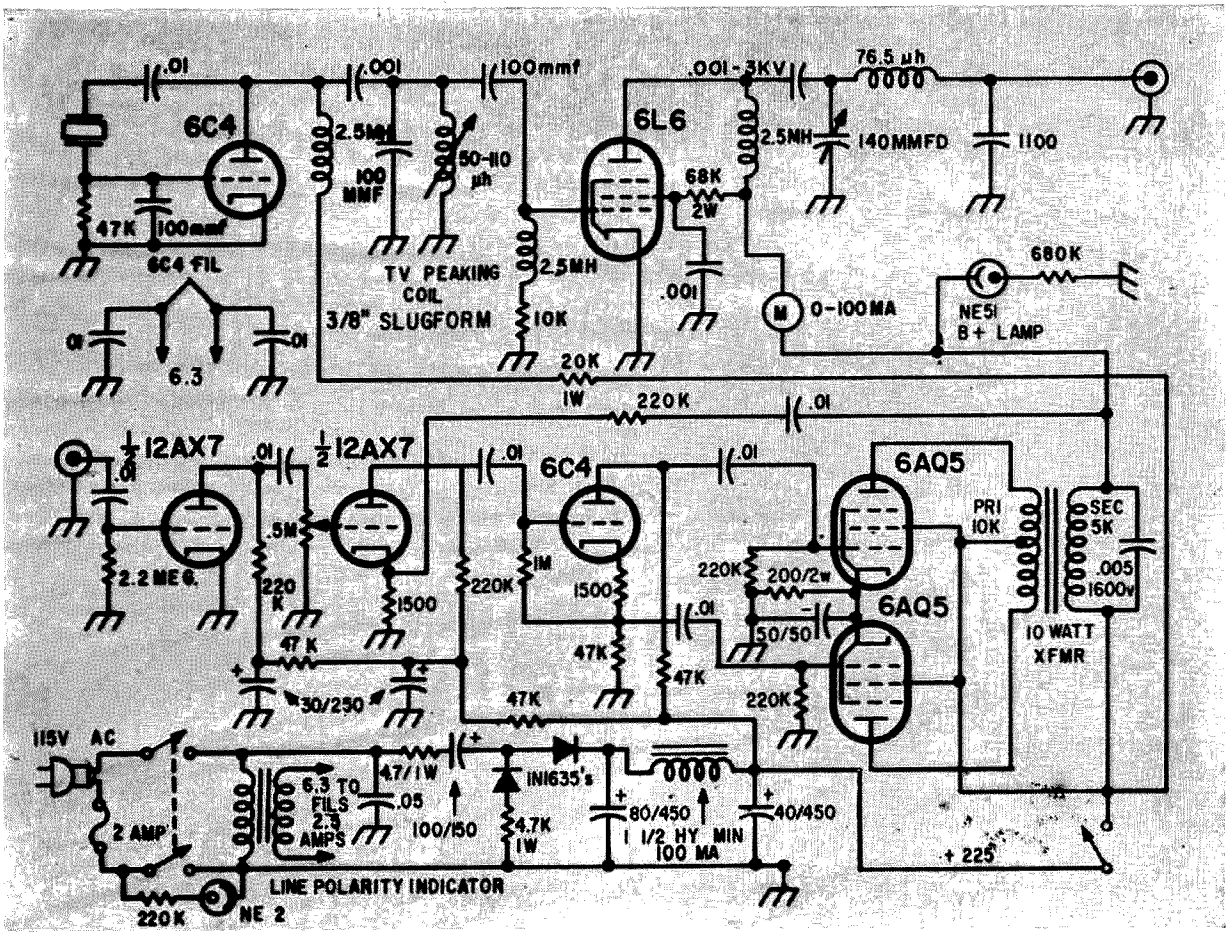
Parts placement is not critical and no shielding between components should be necessary. It is suggested that the modulator be placed as far as possible on the chassis from the rf section. The familiar 6L6 was selected for the final stage because it operates efficiently at the relatively low plate voltage and is usually readily available from the junk box. Grid drive should be adequate when the OSC tuning coil is peaked. If more drive is required, this can be accomplished by decreasing the 20K dropping resistor in the oscillator plate. Grid drive should be near 3 ma.

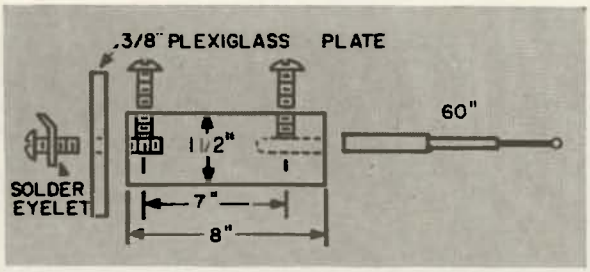
Although the final is capable of more than the 18 watts indicated, the modulator is good for only about 9 watts. If 100% modulation is to be realized the final must be held down to this value.



Cabinet construction is three piece with the 1½" chassis fixed to the front plate by the switches and indicating lamps. The cabinet is wrap around constructed with a partial back panel installed. Two ⅞" chassis punch holes are made in the cabinet, one to allow mounting of the whip and the other to allow the banana jack antenna terminal clearance. This jack is sub-mounted on a piece of ⅛" Plexiglass for insulation. Cabinet dimensions are 6" H x 9" W x 10" deep.

The whip is a 60" automotive replacement antenna. The base loading coil is constructed of Textolite or similar dowel, 1½" dia. 8" long. A 2½" x 2½" square of ⅜" Plexiglass forms the base. This is mounted to the dowel with a single #8-32 screw which is first placed over a solder eyelet. Connection for the winding is obtained by drilling and tapping for a #4-40 of length to jam the #8-32 mounting bolt. An appropriate size hole into the top of the dowel will mount the whip. Again the winding solders to a #4-40 jam bolt (see sketch). The coil is close wound of #22 enamel over 7" of the diameter of the coil. Total turns should be approximately 260. Actual loading of the coil can be accomplished by on the air tests. A simple way to achieve this is to extend the whip fully and tune the final to resonance with the loading capacitor fully closed. The plate switch may be turned off and on, the final "dipped" and the extension whip





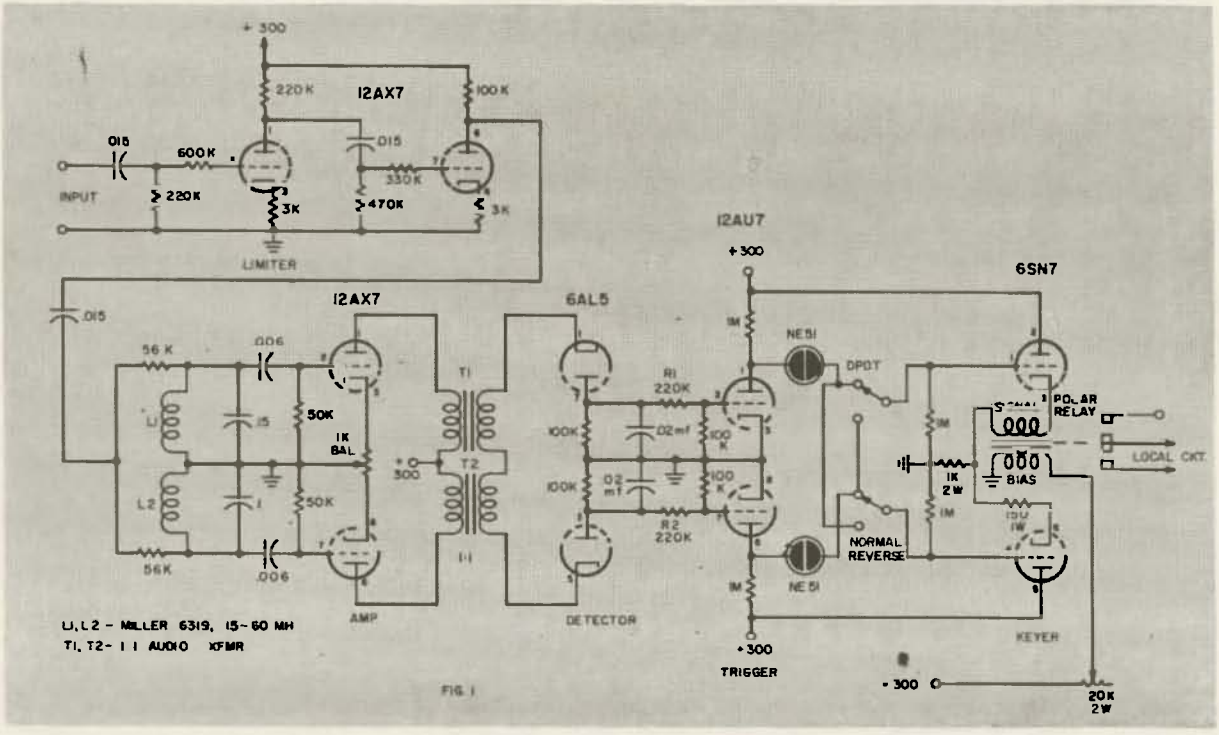
slid down to the point where maximum plate current is drawn while in resonance. This is the tuned point for the antenna. To load it will probably be necessary to extend the antenna ½ inch or so from the tuned point. It is then only necessary to remove a few turns from the whip and extend it again to the tuned point. Remove enough turns to tune the whip about 4 inches from fully extended. This will then allow for variables in loading in different locations where the antenna system is influenced by metal, etc.

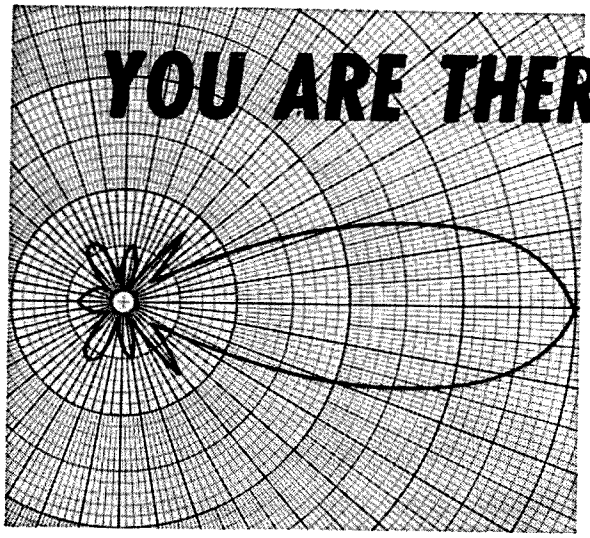
Three of these units have been constructed by your author and they have proven to be extremely versatile rigs to own. Audio quality is excellent, signal output is very good (20 miles on the whip) and no component has failed on any unit after having been in service for several months. . . . K9PAL

Improve Weak Signal Radio-Teletype Reception

Woody Davey W7CJB
329 East Kent
Missoula, Montana

THE circuit in Fig. 1 is somewhat conventional, but with balanced detector, trigger and keyer tubes. A filter circuit consisting of an .02 mfd condenser, two 100K resistors and the 220K resistor form a long time constant circuit in the detector output which completely wipes out noise spikes that could trigger the keyer stage when signals are weak. Observations on the scope indicate all traces of noise spikes are eliminated by this circuit. It can be shown that removal of these condensers during noisy reception will cause very bad garbling of otherwise perfect copy. Note coupling resistors R1 and R2 on the grid of the driver tube. Both resistors are identical, their value being determined by the voltage developed at the plates of the 6AL5 detector. These are nothing more than part of a voltage divider to drop the dc voltage on the grids of the 12AU7 to —8 volts as measured on a VTVM, when the respective half of the 6AL5 is conducting. Transformers T1 and T2 are approximately 1:1 but if substitutions are made it will only be necessary to adjust the coupling resistors R1





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and R2 so that —8 volts appears on the 12AU7 grids when the limiter is saturated and with the proper tone at the converter input. The K1 balance control in the cathode of the 12AX7 amplifier is adjusted to equalize the voltages on the 12AU7 grids when the respective mark or space frequencies are selected. Minus 8 volts on the 12AU7 grid will cause an increase in the plate voltage to at least 60 volts which will fire the neon properly.

The 6SN7 keyer tube could operate balanced with one winding of a type 255A polar relay in each cathode, but I prefer to replace one winding with a 150 ohm resistor and to provide bias current to the disconnected winding. In this case the actual keying is done on space signals, but you have a built-in "mark." The polar relay bias current should be adjusted to exactly ½ the current value of the "signal" winding when that portion of the 6SN7 is conducting. In this case 30 ma in the signal winding necessitated a bias current of 15 ma.

The DPDT switch on the NE-51's allow copy of "normal" or "reversed" signals. Prior to the development of this circuit I had tried several discriminator type detectors followed by various trigger and keyer circuits, but with signals down in the noise, the above converter would outcopy the disciminator type of converter. Comparison was direct, with the two converters side by side.

The TV width coils can be replaced with 88 mh toroids by tuning them to the proper frequencies. The toroids give somewhat better selectivity, and due to the higher "Q" there is an incease in the detector output voltage of approximately 8 or 9 times (who said TV coils were high Q?). With toroids it will be necessary to increase the value of R1 and R2 to 1.5 megohms.

As a matter of interest selectivity curves were run on both the toroids and the TV width coils. The width of the selectivity curve at the ½ voltage point (6db down), is as follows:

	2125 center freq	2975 center freq
TV width coil	570 cps	890 cps
88mh Toroid	180 cps	330 cps

It can be easily seen that toroids would be a definite improvement when the QRM is bad.

Another real problem in radio-teletype reception is selective fading. One does not notice this unless the audio is either metered or observed on a scope. This can be quite severe at times and I have observed as much as 20 db difference in the two tones, fist one and then the other being the stronger. I might suggest the use of separate audio limiters in each channel to help overcome this. Tuned circuits should be used ahead of the limiters to separate the two tones, prior to limiting. . . . W7GJB

Positive Transistor Protection

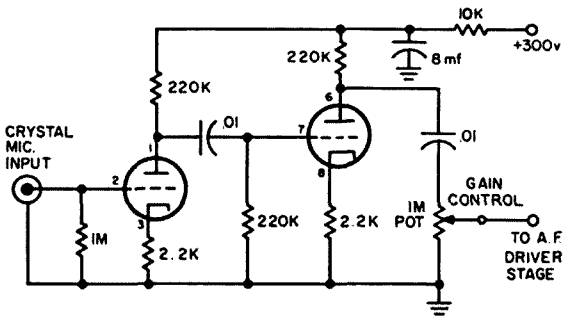
In most transistorized equipment, if the polarity of the power supply is connected backwards, the result is a mass of melted germanium, damaged electrolytics, and an abundance of profanity. With the nine volt or penlight batteries it is quite easy to connect them backwards, especially if you are anxious to try the equipment out or go somewhere. To prevent this, it is only necessary to put a small diode in series with the battery. If the polarity is connected incorrectly, no current will flow so no damage will result. For small, low power equipment, a general purpose diode will work. Where the current is higher than 20 ma. or the voltage higher than 6 volts, a small, low piv silicon diode should be used. . . . WA2INM

Pre-Amp Curve Shaping

Charles E. Landahl W5SOT
121 Barranca Road
Los Alamos, New Mexico

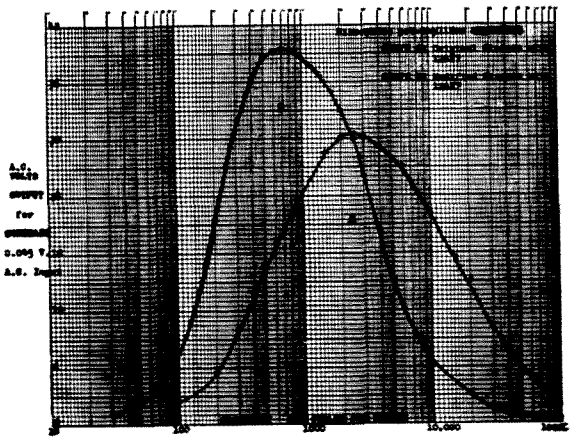
THE following microphone pre-amplifier is presented as a helpful suggestion, and, is a small commentary upon the simplicity of resistor—capacitor filtering. A glance at the experimentally derived curves shows the narrowing of the audio pass band of a common type of microphone pre-amp, when the tube and associated circuit values are changed. The original circuit is found in many amateur applications and borders upon high fidelity practices. It is possible to find transformers for the following stages which will sharpen the bandwidth of the modulator system, however, such transformers are costly to make and are seldom found in moderately priced equipment.

It was fun to experimentally determine an optimum compromise between microphone, tubes, coupling capacitors and plate resistors, which would help narrow the audio pass band of the pre-amplifier shown in the schematics.



Don't be frightened by the low value of input grid resistor, nor the high values of the plate resistors. Remember? We want to restrict the audio range and occupy fewer of the precious kilocycles available to us. The low value of input grid resistor helps to get rid of the low frequency response of a high impedance crystal microphone. The high value of plate resistors tend to keep the voltage gain up and assist with the attenuation of frequencies either side of 750 cycles per second. The .001 mfd coupling capacitors contribute to low frequency roll off, while the .001 mfd plus the 39K series resistor shunting the grid of the second stage puts the finishing touch to the higher frequency roll off. The results obtained with the completed change is demonstrated in the curves and makes you feel as though you have done something to help your transmitter put out a more conservative frequency spectrum.

A detailed inspection of the curves show "A" as the amplification characteristic of the original circuit. Curve "B" is the character-

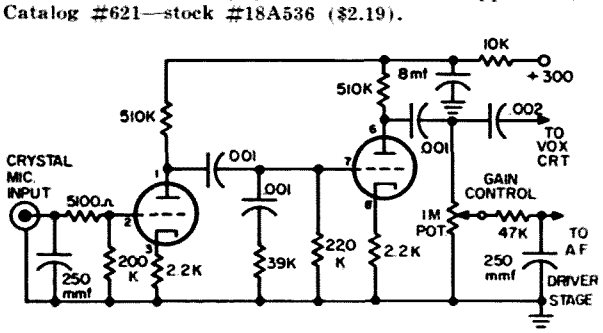


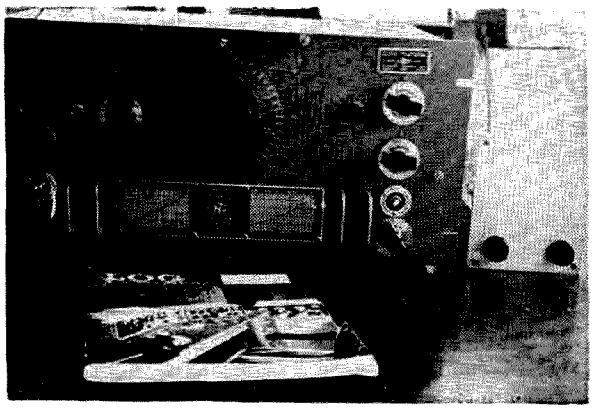
istic developed by the changed circuit. In both cases the input voltage to the microphone jack was held at 0.045 volts ac, rms, as measured by a vacuum tube volt meter. Output was taken at the junction of the 47K resistor and the 250 mfd capacitor shown to the right of the gain control by means of VTVM. Note that the band width at the half voltage points is approximately 19.5 kc for the original circuit. It becomes approximately 3.8 kc for the modified circuit at the same point. Further comparison at the 3 dbv down points show 10 kcs for the original versus 2.3 kc for the modified. This is a modest but valuable improvement. It is especially valuable for those of us with low resonant voices. A high impedance crystal microphone, rated at -54 dbv* will produce full undistorted output from a Central Electronics Model 10-B exciter, with the gain control adjusted to ¾ open. Another application might well be found for the Heathkit SB-10 since it uses the 12AX7 tube in its pre-amp circuit.

A few words of caution: Experiment has shown that there must be no substitution of types of tubes in the modified circuit. Those other than the 12AX7 will produce insufficient gain and the amplification curve will be shifted to the right and undo the apparent good. Also, remember that this is a *crystal* microphone pre-amp. Don't drive the circuit with a carbon microphone. Hold the input voltage to 0.045 volts or less.

Crisp intelligible communications is the best recommendation for this circuit. Why not try it? . . .W5SOT

*Like the one on page 173 of Burstein-Applebee Co. Catalog #621—stock #18A536 ($2.19).





Dick Gridley K6JHJ
Edison Powerhouse #8
Auberry, California

Photography by Linda Gridley

The BC453, One More Use

THE slicer to be described here came into being because of crowded band conditions and an unyielding XYL. The simple solution, of course, is the purchase of a new receiver —but this approach brought only lumps, and I knew I couldn't talk 75% of the hams in California to leave the air.

The need was for a sharper receiver for CW and a good method of detecting Single Sideband. Both of these requirements were filled, plus a fine method of detecting AM was gained.

The heart of the slicer is the 85 kc filter which is constructed from the *if* transformers of the BC453. The filter is not flat on top, but it has a good shape factor. The 3 kc points are 5 DB down and at 6 kc the attenuation is 35 DB. This is a pretty fair filter for the price. I had a BC453 in the junk box—if you don't, there are ads in 73 selling them for $9.95 and this is a lot less than any filter on the market.

The product detector is the one described by ZL1AAX in the August '59 CQ magazine.

The mixer is the "like-new" mixer described by the staff in the October issue of 73. The choice of the 6J6 was made because the original slicer used a 6BE6 mixer and I didn't want to change the socket.

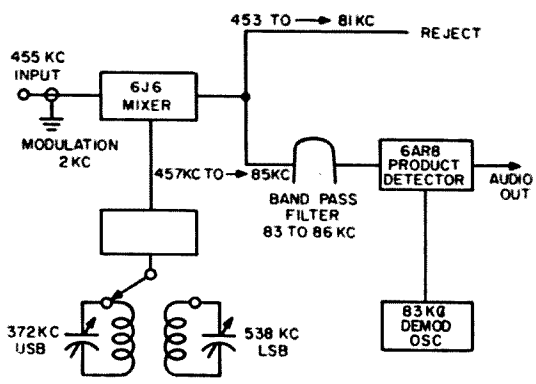


FIG. 1

The operation is simple, and if you follow the block diagram Fig. 1, it is easy to see. Starting with the incoming signal of 455 kc into the 6J6 mixer, it is mixed with the selected oscillator frequency of either 372 kc USB or 538 kc LSB. The fundamentals tell us that in this conversion there will be four frequencies—the incoming frequency, the oscillator frequency, and their sum and difference. In this slicer we are only concerned with the difference.

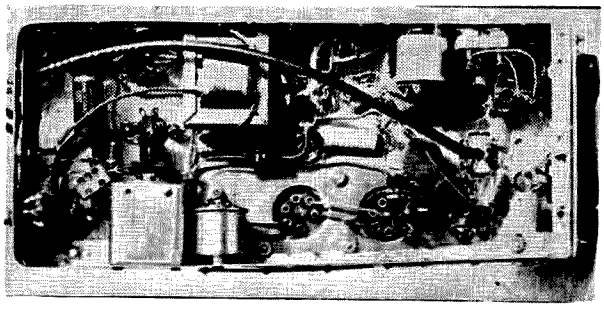
A little math at this time will show that 455 kc less 372 kc is 83 kc, and 538 kc less 455 kc is 83 kc. The differences are the same. However you will note that we position the oscillator either 83 kc above, or below the carrier frequency of 455 kc. We will now add a 2 kc modulating frequency to the carrier. Going once more to fundamentals, we know that we now have the 455 kc carrier with a 457 kc USB and a 453 kc LSB.

For simplicity of explanation, let us leave the 455 kc carrier at this point and consider only the sidebands as they enter and leave the mixer. If the selector switch is placed on the USB position the oscillator will inject into the mixer a frequency of 372 kc. The upper sideband of 457 kc will convert to and leave the mixer at 85 kc and the lower sideband of 453 kc will convert and leave at 81 kc. If the selector switch is set on the LSB position, the oscillator will inject into the mixer a frequency of 538 kc, and now the upper sideband of 457 kc converts and leaves the mixer at 81 kc and the lower sideband of 453 kc converts and leaves the mixer at 85 kc. Simple, what?

Looking now at Fig. 2, the band pass filter, you will note that the 85 kc point is in the middle of the filter and the 81 kc point is placed down the skirt of the filter to a point that gives a rejection of 40 DB. Thus, with the selection of the sideband switch, we can select or reject the sideband we want.

The selected sideband is then fed to the product detector and is beat against the low frequency demod oscillator. The output to the audio stage is the difference (85 kc less 83 kc) 2 kc. It will be noted, I hope, that this explanation is for the purpose of understanding the slicer operation, and in practice is just the reverse of the alignment.

The use of the sheetbeam tube as a product detector has been covered in many good articles and will not be repeated here.



The audio section is also skipped as any pet circuit will work as well as this one. In fact, the choice of tubes and components in my slicer was a matter of what was in the junk box and not a matter of choice. ZL1AAX said in his article that the 6AR8 is as extinct as a Dodo bird, and it might be well to consider the 6BU8 or the 7360.

Construction is straightforward. Extra care should be taken in the construction of the oscillators. They must be stable within 30 cycles. This is easily accomplished by the use of high quality parts and rigid mounting. My unit was constructed on the old BC453 chassis, fitted with a new face and deck made of 3/32 aluminum. The only question that might arise is power. The base station here uses a common power supply and has power to spare. If your receiver does not have enough reserve, it might be well to consider a chassis big enough to make the unit self contained with its own power supply.

Before dismantling the BC453, you should have a schematic. If not, you can mark the BFO coil and the *if* transformers when removing them. The BFO coil was used as is, the *if*

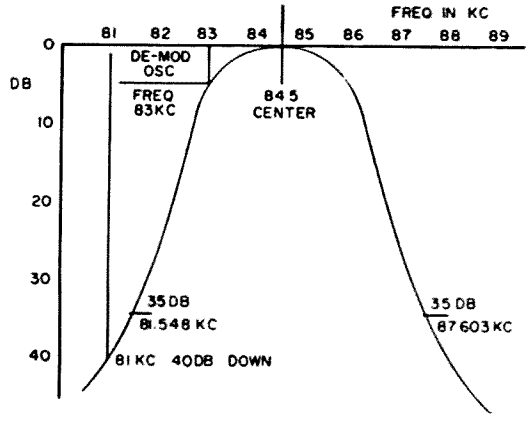
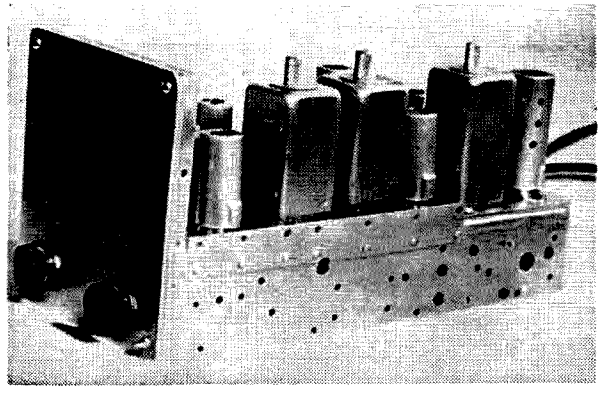


FIG. 2

transformer covers were removed and wires were soldered to the inside lugs and brought out the bottom. This way I was able to use the base mounting ears to mount them to the new chassis with 4/40 machine screws.

A note of warning here, the 3X.05 capacitors in the BC453 should be checked for leakage. Remember these are at least fifteen years old, and I have found that about 50% of them are bad—this kind of trouble we don't need.

T1 is a Miller K-TRAN 12C1 455 *if* transformer. T2, T3, and T4 are the 85 kc *if* transformers from the BC453. T2 is the input, T4 is the output. The gimmick between T2 and T3 is three turns of the two leads twisted together and doped. T5 is a Stancor A53C, 1 to 3 interstage, plate to grid transformer connected in reverse. T6 is a standard audio output transformer. The one I used was removed from a Philco TV set. T7 is the 85 kc oscillator coil removed from the BC453.



Now comes the tough one. L1 was made from an old 262 kc *if* transformer that was way down in the junk pile. I believe it came from an old car receiver. I removed the shield can and kept the ceramic form and both padders in tact. The two padders are C1 and C2 which are mounted on the chassis with one winding of the 262 kc *if* transformer. L2 was made from a self-supporting 2.5 mh RFC. I removed about 20 feet of wire from the winding of L1. L2 was made by removing 1 pie from the RFC. However, I think the best way to approach these coils is with a BC-221 which is covered in the alignment. I do feel this is the one point of failing in this unit. It would be better to pick up a couple of slug tuned inductors, for you who are lucky enough to live near a radio store, as these *if* trimmers were never made for vernier tuning.

The first step in putting the slicer into operation is the pruning of L1 and L2 to frequency. So let's take L1, this will be the 372 kc oscillator. Compress C1 and C2 about ¾ closed. Fire up the BC221 and check the frequency at pin #5 of the 6J6 mixer. Start removing turns until you are close. I removed about 20 feet of winding from this one I used. Then repeat the process on L2, which is the 538 kc oscillator coil. From this one I removed one full pie from the RFC. You should come

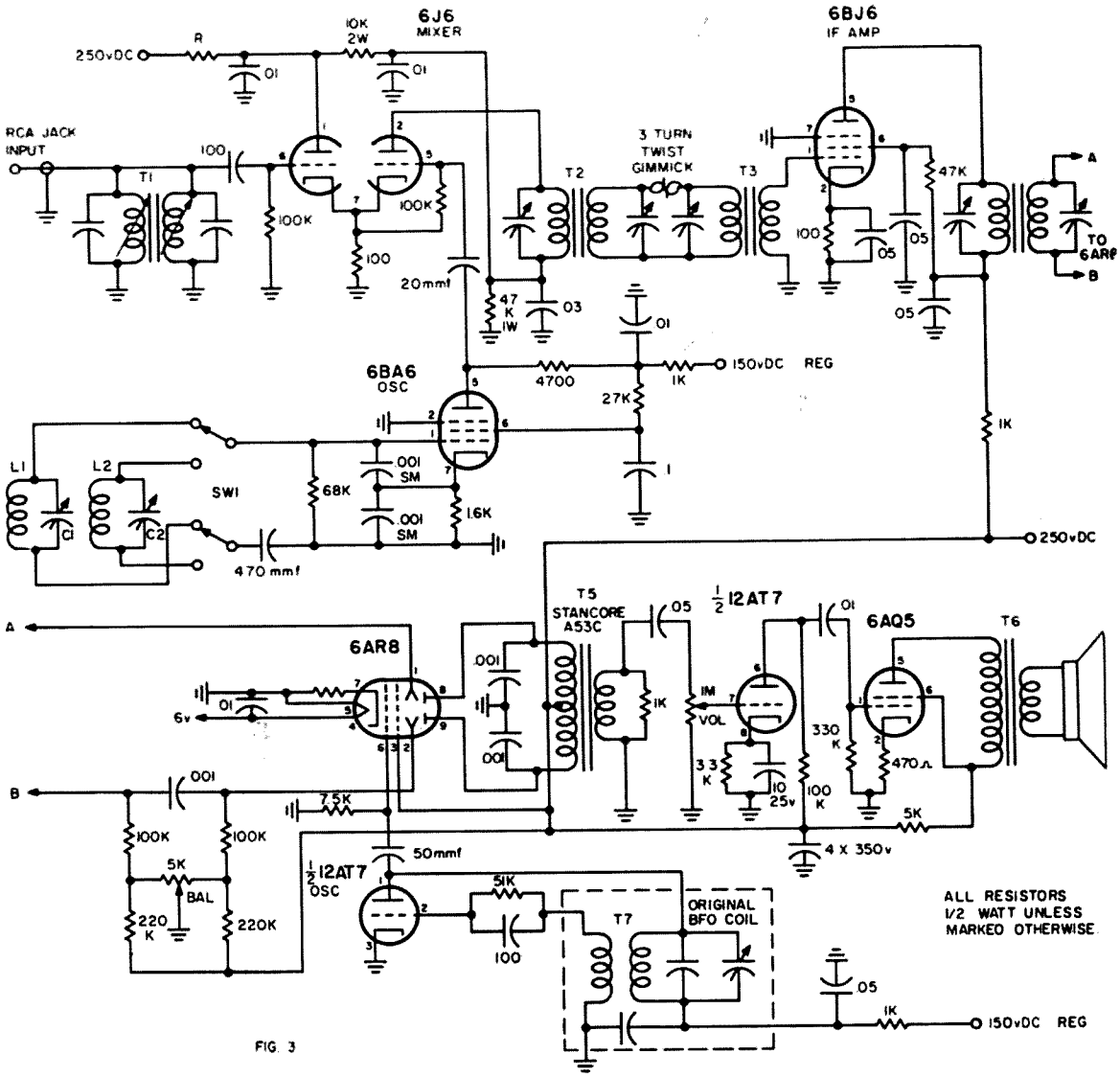


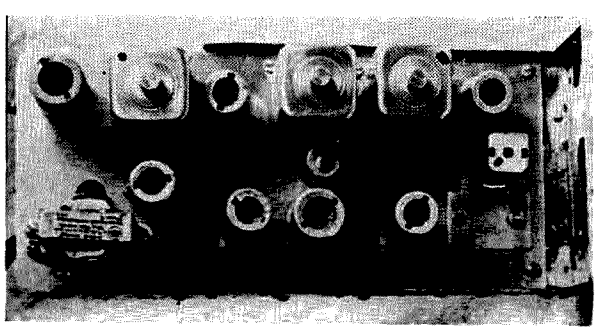
FIG. 3

close enough so you can change the frequency about 4 kc each side of the desired frequency.

Set the resistor, marked R on the schematic Fig. 3, until you have 150v at pin #1 of the 6J6 mixer.

If you have a low frequency oscillator, such as the Hewlett-Packard 200 and a VTVM, the alignment of the filter is standard and should be peaked up at 84.5 kc—then set the slicer's low frequency oscillator at 83 kc.

Another way that works out well is to use the low frequency oscillator of the slicer for the alignment generator. Make sure that the low frequency oscillator is running at its highest frequency. This check is best made by removing the cover and making sure the condenser is fully opened, minimum capacity. Remove the 50 mmfd condenser from pin #6 of the 6AR8 and use this to insert the signal into the filter. Peak the filter for maximum output at pins #1 and #2 of the 6AR8 and then slide the oscillator's frequency down until you have a 5 DB loss. This will put the filter center at about 83 kc, as the low frequency oscillator's highest frequency is about 83 kc. This will not effect anything except the exact frequency of the sideband selector oscillator.



I used a Hewlett-Packard 200 oscillator, 400D VTVM, an Erie counter, a low frequency sweep generator, and a Tektronix 316 scope to set this one the first time. Then thinking you fellows may not have access to the equipment that I do, I detuned this one and worked the alignment mentioned earlier using the slicer's low frequency oscillator as the alignment generator. It proved out very close to the original figures and no difference was noted in the performance.

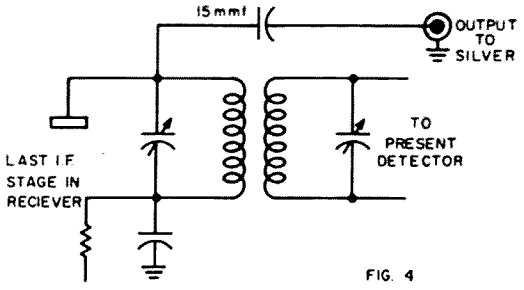


FIG. 4

The next step is to make sure that the injection level is correct at both mixers. With an rf probe on the VTVM, check at pin #6 of the 6AR8, it should be between 2 and 3 volts. The coupling shown gave me 2.7 volts. Next, check pin #5 of the 6J6 mixer for 2 volts. The coupling shown gave me 2.1 volts.

We are now ready to put the slicer into operation. Connect the slicer to the output of the last *if* stage in the receiver through a 15 mmfd condenser, Fig. 4. Tune in a strong AM. signal and peak up on the S. meter. Turn off the AVC and turn the rf gain to about ½ open. Turn the audio up on the slicer and tune C1 or C2 (which ever one is in service) to zero beat. This will give natural sounding audio. Now change the selector switch and repeat for the other trimmer condenser. You should be able to switch from USB to LSB with no noticeable change. Adjust the 5K balance pot in the 6AR8 circuit for minimum intermodulation distortion and that is it.

The only check left is for your own satisfaction and proof that the product detector is doing all that it is supposed to. All the articles tell you that the only thing demodulated in a product detector is that which beats against the oscillator. Therefore, if you kill the low frequency oscillator, the slicer should go dead and if it is working correctly, it will. The measured carrier leak with the oscillator off, in my slicer, is down 45 DB.

This unit will please the most discriminating ham with its performance not only on SSB. detection, but on CW. and AM. phone as well.

I feel the big bonus is the use of it on AM. If you are copying a station and another station comes in close enough to cause heterodyne, all that is needed is a flip of the switch to select the other sideband and exit heterodyne.

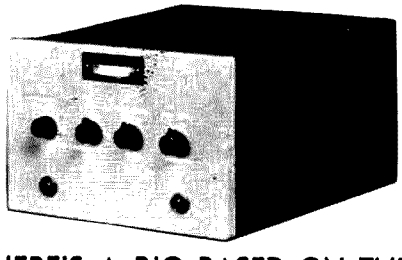
The first time I tried it on CW I thought the slicer was dead, but tuning across the band the signals seemed to jump out from dead silence.

It is a real nice addition to any shack, and if all the parts were purchased from scratch I don't know how the cost could go over $20.00.

All that is left to say now is—start digging into the junk box and heat the soldering iron. The enjoyment received from the hetereodyne-free operation of this unit is well worth the time it takes to build it.

. . . K6JHJ

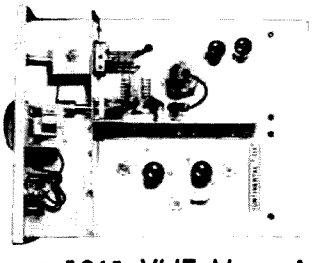
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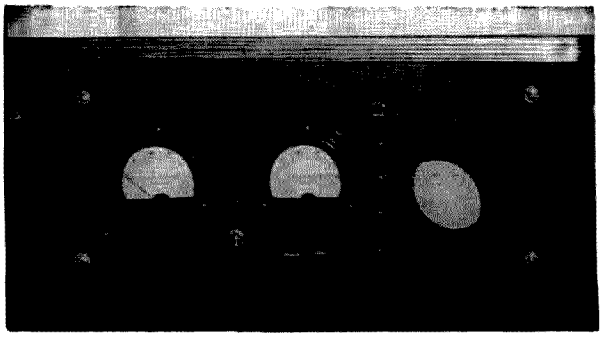
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John T. Reeder
WØMWJ
Route 1
Kennett, Mo.

Linear Scope Monitor

ONCE the excitement of getting the big gun on the air has subsided and you are satisfied that you are getting out, there eventually comes a time when the SSB operator begins to wonder just what his signal looks like.

This is one approach to getting a visual monitor, using a minimum of readily available parts and it can be incorporated as a permanent part of the rig.

This is not an all purpose scope. It is designed to produce a trapezoid pattern for monitoring a linear amplifier.

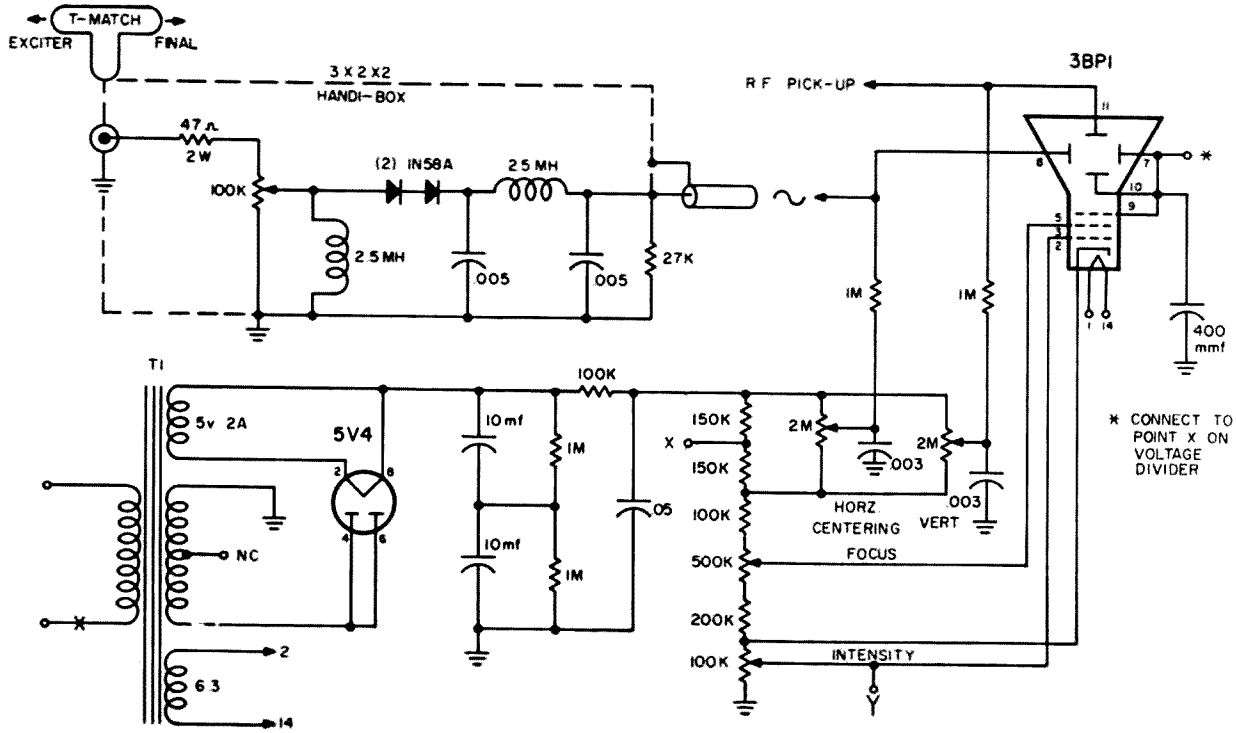
A sample of the signal from the exciter is taken off through a "T" connection between the exciter and the input to the final. This signal is rectified and filtered by the 1N58A's in series and associated circuit. Two diodes were used to provide ample voltage to drive the deflection plates of the scope tube without further amplification. The voltage divider at the input to the diodes sets the width of the pattern on the scope tube and must be re-set for each band.

Vertical deflection is derived by a simple rf pick-up from the final tank coil. A piece of insulated wire looped through the turns of the final coil can be adjusted to produce the correct amount of drive to match the input to the horizontal plates.

If the final output is linear with the input you get a nice straight sided triangle. Overmodulation and loading difficulties show up readily.

A blocking bias can be applied to point "Y" from the exciter to provide cut-off of the beam during periods of stand-by to prevent burning the picture tube. Or, if you're not fussy, simply turn down the intensity after you have tuned up and are operating. If you change bands or move enough to re-load, it's a simple matter to turn up the intensity and say HALO a time or two while watching the scope.

The construction can be adapted to match your rig. In our case the rig had a meter panel



which included a thermo-couple RF meter that didn't tell us much. The scope tube was mounted to occupy the hole left when we took the meter out. The works were mounted on a "U" shaped chassis from an old BC-191 tuning unit. The panel controls were sub-Mounted on a strip of bakelite and extended through the front panel with polystyrene rods.

All resistors are 1 watt unless otherwise noted and the condensers should be chosen to match the voltage encountered at the point of use. The voltage divider potentiometer in the horizontal pick up unit is a TV insulated shaft model to prevent rf break-down. The power transformer can be any available small receiver type which will produce about 800 volts total in the high voltage winding. This voltage will produce sufficient intensity for easy observation in room light and allows direct drive of the deflection plates without amplification.

Two tubes and a few parts from your junk box and you're sure your final is clean.

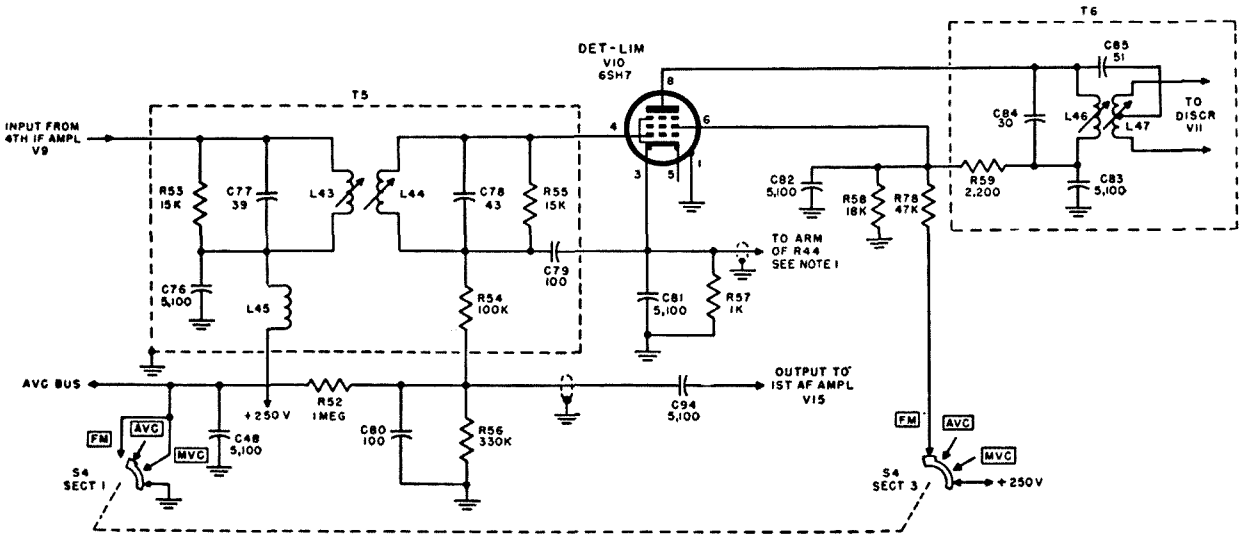
. . . WØMWJ

FM to AM

A recurring problem in surplus application is the conversion of an FM receiver to receive AM signals. This requirement often demands that the original FM circuitry be retained and either AM or FM reception be possible on a switched basis. Although many approaches to this problem have been employed, the circuitry is often complicated and the results are not always the best.

This problem is solved in a very straightforward manner in some of the older military equipment. The SCR-616 Radio Receiving Set, which used either the BC-1269, BC-1269A or the R-593/GRR Radio Receiver, is the case in point. In these receivers, the audio component developed across the limiter grid resistor is used to drive the audio amplifier directly. In addition, the dc component developed is filtered and used as the AVC voltage source in the AM mode of reception.

The schematic diagram shows this application in detail. There is nothing sacred in the component values shown or in the switching circuit used. Normal precautions in the area of AVC isolation and filtering should be observed. Also, unless excessive distortion or signal leakage occurs, there should be no requirement for removal of the limiter plate voltage in the AM mode. The technique described has considerable merit and should have wider application than is now the case. . . . W4WKM



AM detector circuit for FM surplus Gear. Note: Cathode of V10 is grounded by R44 for AM reception.

Don't Wreck That Meter

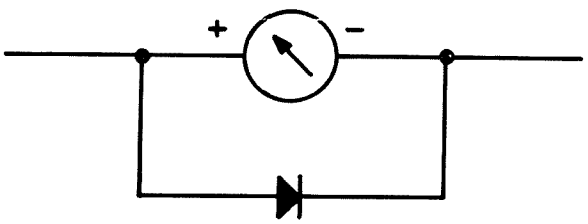
Fred Conner W9CUK

A recent article in 73 described a method of protecting meters from burnout. Perhaps an elaboration of this will be of interest.

Probably each of us has at one time or another overloaded an instrument. Simple fusing will not prevent burnout, or bent pointers in the case of severe overload.

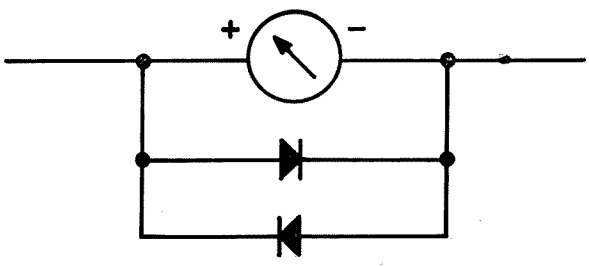
Let us examine the ordinary direct current meter movement. Most milliammeters, microammeters, and ammeters have a full scale deflection voltage of 0.1 V, or less. Inquiries

to meter manufacturers, and tests on typical meters indicate that overloads of about 10 times normal full scale voltage, or 1 volt, will seldom damage coils or pointers. Now, most silicon diodes have a very high resistance at 0.1 volts. However, as forward voltage across the silicon diode exceeds about 0.1 volts, the diode resistance becomes relatively low and, until the diode current reaches a level greatly exceeding the current rating of the diode, will seldom exceed a volt. Extreme overload will cause the diode to short rather than open.



In Fig. 1 the diode is paralleled with the meter terminals. This may be a meter in current measuring usage or a voltmeter, bridge, etc. At normal meter full scale or less the diode will not effect the meter accuracy, however, in overload the diode will clamp at less than harmful currents and no damage will ensue to either meter or diode, up to the current rating of the diode. When the overload is removed, everything will be normal and undamaged.

The ordinary inexpensive "top hat" silicon power diode of ½ ampere and about 400 v PIV rating will protect even sensitive microammeters up to 500 ma. or more. At great surge or overload the diode will short and be destroyed but will still save the meter. Where a possibility of greater current exists, diodes of larger ratings may be employed. Fig. 2 shows the use of 2 diodes. Here, as is not true in Fig. 1, overload of any polarity will not cause meter damage. Circuit 2 will also protect against any ac overloads, within the limitations of the diodes.



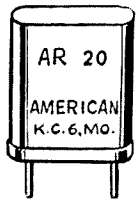
In conlusion, mention is made of experience in a large communications manufacturing plant. For the past several years the methods described above have virtually eliminated burnt out or bent pointer damage in many pieces of factory equipment which are normally subjected to frequent and severe overloading. Sensitive meter type relays have also been thus protected with complete elimination of previous frequent and costly damage.

. . . W9CUK

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$3.50 30 mc to 50 mc



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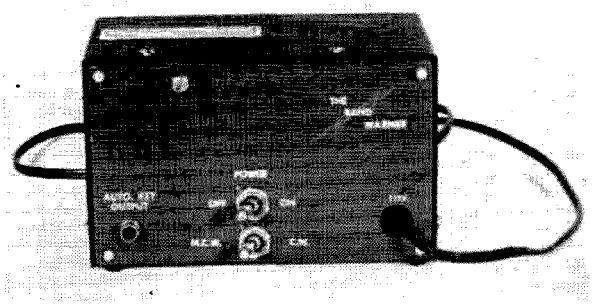
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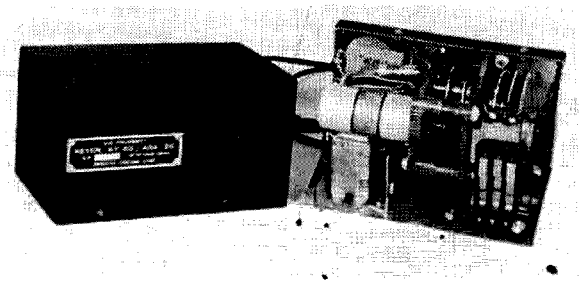
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The Band Warmer





THIS modification to the Keyer KY-65/ARA-26 provides the builder with a unit that will automatically key a transmitter in the CW mode or will modulate a transmitter in the MCW mode. Code discs are used to determine the message sent.

The KY-65/ARA-26 Keyer is available from several surplus houses. I purchased mine from R & W Electronics, Chicago, Illinois. The first thing I did was strip out all parts down to the bare chassis. A new overlay panel was fabricated for the front of the box to cover up the connector holes and improve appearance. The motor and disc assembly was disassembled, cleaned, and the micro-switches removed from the frame.

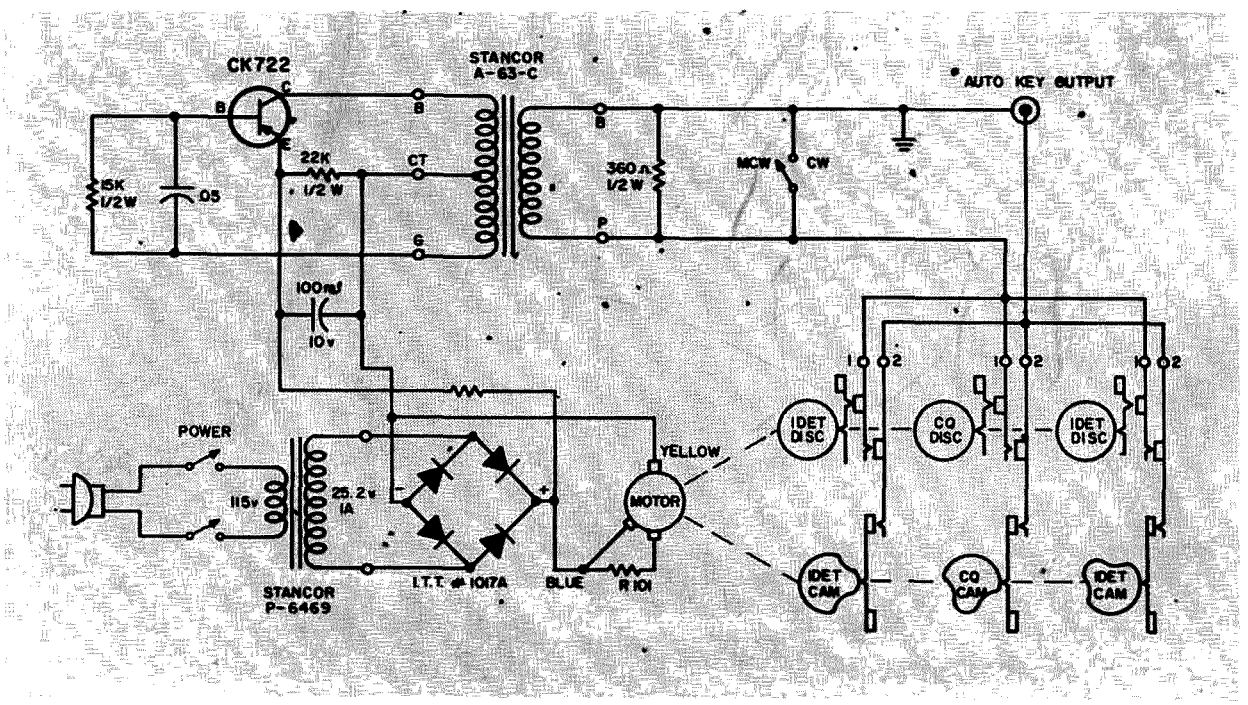
A bracket of aluminum was formed to support the transistor audio oscillator output transformer, selenium rectifier, and terminal strip. It is mounted underneath the motor next to the power transformer. The CK-722 transistor is supported by its leads attached to the terminal strip. The SOS disc and the plastic code disc were replaced with new discs. The disc in the SOS position now sends DE-WφRQF and the identification disc sends WφRQF. The center disc is usable as is or may be replaced with one cut to send CQ. The new discs should be filed and sanded as smooth as possible to prevent excessive wear to the wiping contacts on the keyer assembly.

When using the unit in MCW mode on the VHF bands, the output is connected to the telephone patch or microphone input of the modulator.

On the HF bands in the CW mode the output is plugged into the key jack of the transmitter.

This gadget is very handy on VHF DX contests, warming up the band, equipment testing, and propagation studies—any other ideas?

... WφRQF



Home Brew Bridge Calibration

This table is useful for all homebrew SWR bridges and gives the % reflected power and the % full scale reading in the reflected mode, when the meter is set at full scale in the forward mode.

SWR	% Pwr. Refl.	Refl. Rdg. in % of Full Scale
1.1	.2%	4.8%
1.2	.8	9.1
1.3	1.7	13.1
1.4	2.8	16.7
1.5	4.0	20.0
1.6	5.3	23.1
1.7	6.7	25.9
1.8	8.2	28.6
1.9	9.7	31.1
2.0	11.0	33.3
2.1	12.6	35.5
2.2	14.0	37.5
2.3	15.5	39.4
2.4	17.0	41.2
2.5	18.4	42.9
2.6	19.7	44.4
2.7	21.1	45.9
2.8	22.5	47.4
2.9	23.8	48.7
3.0	25.0	50.0
4.0	36.0	60.0
5.7	49.0	70.0
9.0	64.0	80.0
19.0	81.0	90.0

. . . W4OAB



Unmatched performance, mobility, versatility with the DAVCO Model DR30 communications receiver:

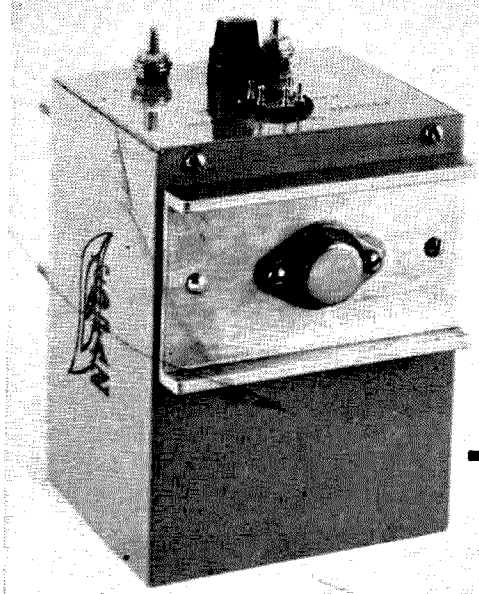
double conversion, mechanical filter selectivity, extreme stability; all the features you want and need for only $289.50 ready to go. Write for full information on the receiver and associated exciter-linear units.

(Our orders are still on a waiting-list basis, and thanks again for your tremendous interest in our new product line!)

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New models are now available designed specifically for or adaptable to the following applications:

C10W	C10WG	C10WDG	C10WDD	C10XDG
600 vdc (.415A) 300 vdc (.5A) 120 vac 400 cps	600 vdc (.415A) 300 vdc (.5A) 0-120 vdc bias	600 vdc (.415A) 300 vdc (.5A) 0-120 vdc and Relay	650 vdc (.325A) 270 vdc (.13A) LC filter and 2 Relays	800 vdc (.325A) 280 vdc (.21A) LC Filter and Relay −50 to −90 vdc bias
Johnson Viking Mobile	Collins KWM-2	Swan, all models, Collins KWM-2	Gonset "G-76"	Collins KWM-1, 2
$79.50	$89.50	$99.50	$119.95	$134.95

NOTE: Any combination of above outputs — up to 250 VA total maximum, except C10XDG — 260 watts.

GENERAL SPECIFICATIONS FOR ALL MODELS

Input requirements: Voltage 11-15 VDC. 13 volts nominal
Efficiency: 85%
Weight: Approximately 7 lbs.

*Patent Pending.

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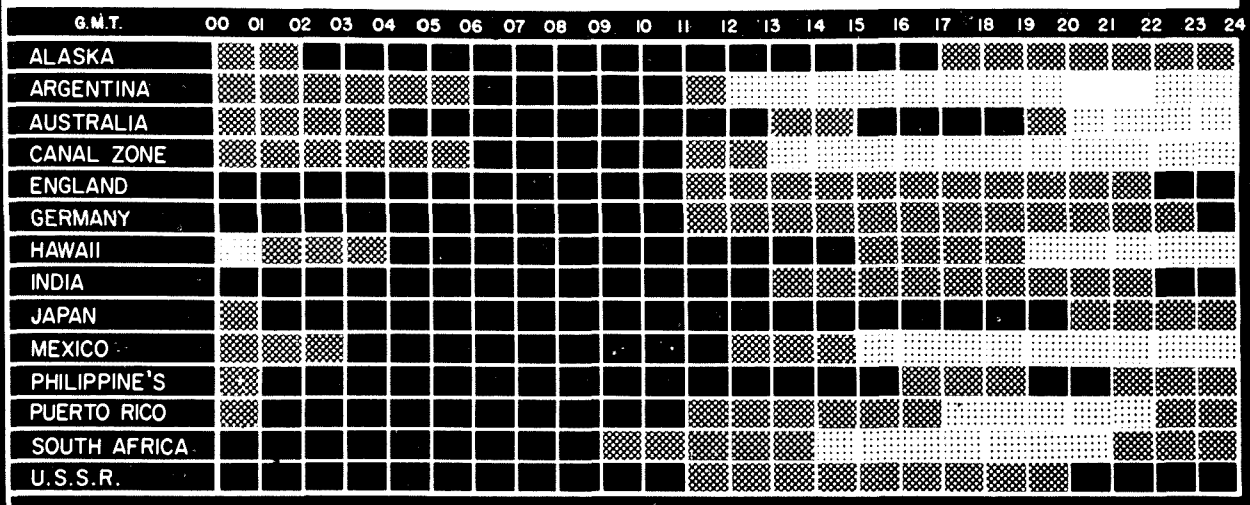
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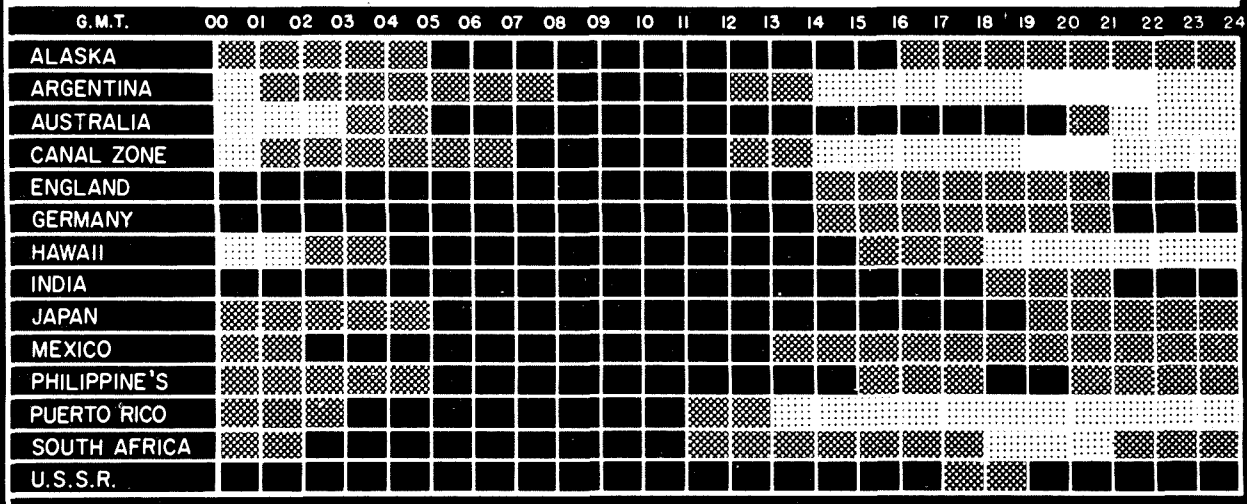
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PROPAGATION CHART

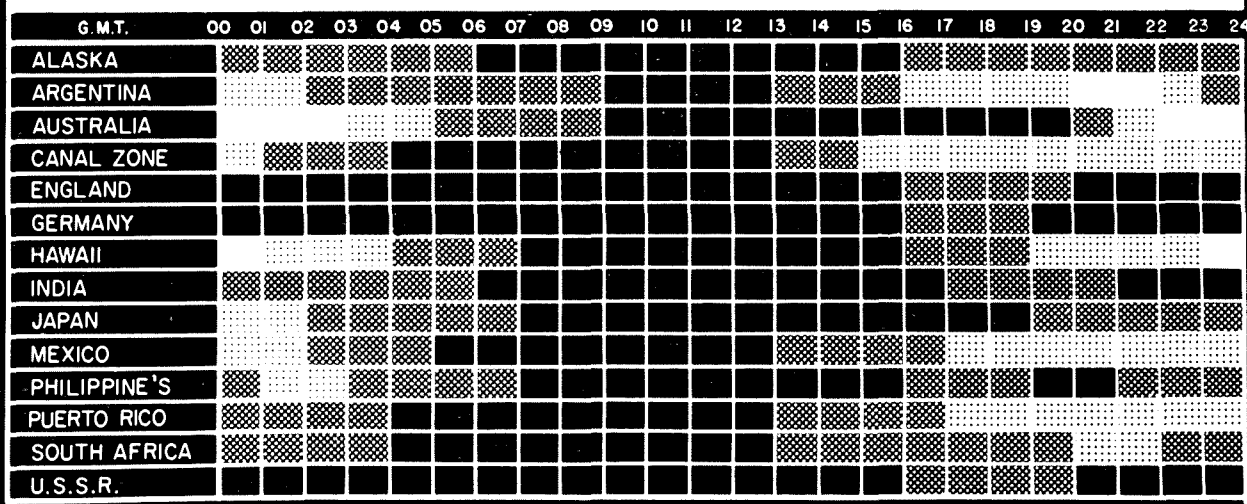
EASTERN UNITED STATES TO:



CENTRAL UNITED STATES TO:



WESTERN UNITED STATES TO:

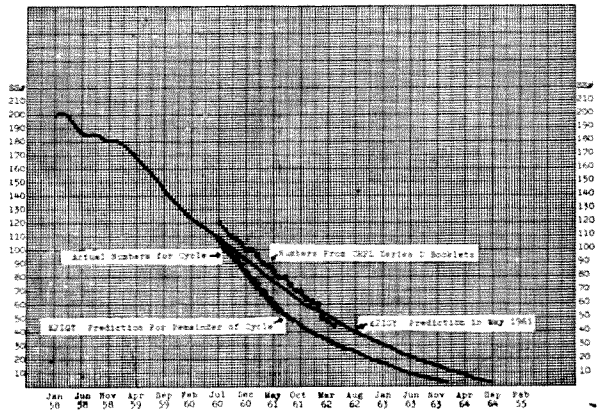


Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miama (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miama. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.



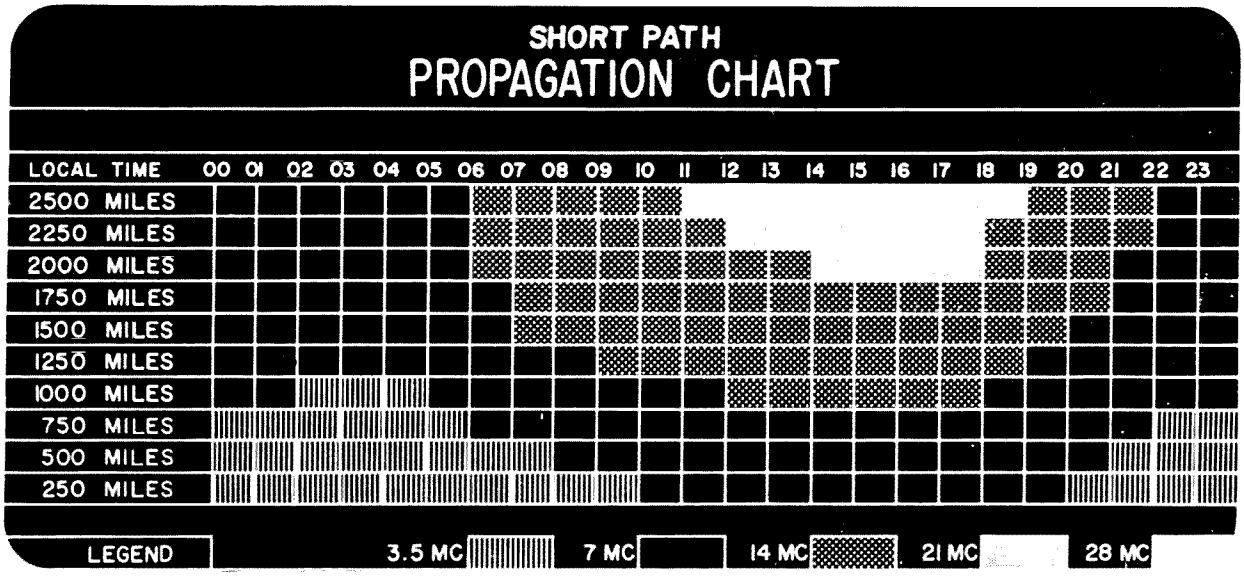
Advance Forecast: April 1962

Good: 8-11, 17-20, 23-29

Fair: 1-3, 6-7, 12-13, 15-16, 21, 30

Bad: 4-5, 14, 22

Things could be worse



Technical Manuals for Surplus Equipment

Non-availability of technical information on surplus military electronics equipment has long been a serious problem. While certain surplus dealers specialize in the sale of such manuals, the selection is anything but complete. The Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C., is one source of manuals published by the military services but, once again, the selection is very small.

Manuals stocked are limited to general reference books and texts and few, if any, instruction manuals on specific equipments are available from this source. Publications on the general subject of radio are listed in several price lists which may be obtained by writing the Superintendent of Documents. Price lists PL 19 (Army), PL 63 (Navy) and PL 82 (Radio) are pertinent. Of the 22 Signal Corps Technical Manuals listed by GPO in PL 19, 19 are general reference manuals or training texts and 3 deal with air navigational facilities.

Incidentally, one item in PL 19 is deserving of special mention. Army Technical Manual, TM 11-690, "Basic Theory and Application of Transistors," at $1.25, is a very fine buy. This book packs a lot of information in its 263, 8" x 10" pages. This book starts with the basic principles of solid state devices and carries you through advanced circuits.

One little used and quite productive source of current Army Technical Manuals is the Department of the Army, Office of the Adjutant General, Washington 25, D. C. Unfortunately, this office does not publish a listing of publications that are available for sale since the status and price varies unpredictably. Of the unclassified, current Signal Corps Technical Manuals, approximately half may be bought from this source. The balance may not be sold, either because of limited stocks or because they contain copyrighted or proprietary material.

Manuals are still stocked for some of the World War II, and earlier, equipment, although availability is quite spotty. One category of equipment poses almost insurmountable problems. Old Army Air Corps equipment manuals that were phased out of Army channels and not picked up by the Air Force are simply not available. The publications should be ordered by number to insure that you get what you want. This may be a problem, although most Army surplus equipment has a warning plate or decal installed which reads something like "Before Operating This Equipment, Review TM 11-....."

All in all, the AG source is quite productive and it is certainly worth a letter to the Department of the Army to determine the status of the manual you need. Address your request to the above listed Washington office, attention: AGAM.

Those who live in the Washington area may take advantage of the services offered by The Library of Congress. Extensive microfilm files of military publications are maintained and photographically reproduced copies of a single page or an entire publication may be purchased. Prices are in line with commercial charges for photostats, so reproduction of a complete manual would probably be prohibitively expensive. However, a single schematic diagram could well meet your requirement and, for a single page, the cost is within reason.

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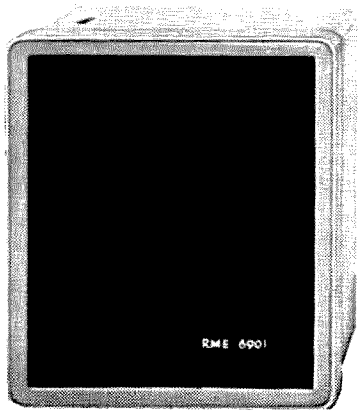
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Precision Measurement for the Amateur

Roy Pafenberg W4WKM

As his construction projects become more complex, the amateur often discovers that the general run of test equipment designed for the service industry does not completely meet his requirements. In addition to the generally accepted lack of accuracy existing in the trade instruments, there are certain circuit parameters and component characteristics which are simply not measurable with equipment of that category. If at this time the basement work shop amateur is exposed to the test equipment and techniques of a modern research or engineering activity, his dissatisfaction with his own equipment and methods increases space.

The cost of laboratory instruments to equip a small electronics engineering or development shop with the basic minimum of modern test instruments can easily exceed $25,000. This figure does not include specialized equipment for work in such areas as microwave, but is limited to general purpose instrumentation. Obviously, such an investment is not warranted for even the most inveterate amateur constructor.

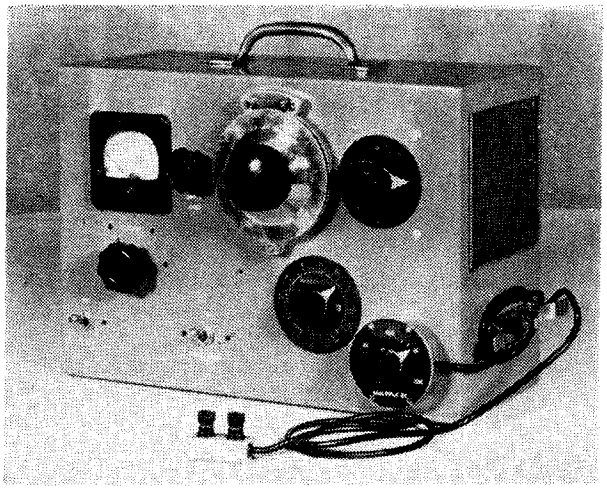
A review of the precision instrument catalogs of the last two decades will reveal that many types of instruments have increased in cost far more than the shrinking purchasing power of the dollar would justify. Comparison of formerly available instruments with the current crop does not, in most cases, show any great improvement in basic accuracy. While there have been some changes in the approach to precision measurement. most instruments have simply become more complex in order to provide increased operating convenience and to conserve valuable engineering time.

Good examples of this developmental trend may be found in the field of audio and radio frequency measurement. Frequency meters, along with primary and secondary frequency standards, have been available for years and the basic limitation on accuracy has been that of the standard or calibration oscillator. These instruments, through the use of transfer and interpolation oscillators, detectors and indicators, can precisely determine the frequency of an unknown signal. Frequency counters were then developed to speed up these measurements. These instruments, using computer techniques, continuously and repetitively display the frequency of the signal being measured by means of read out indicators on the front panel of the instrument. This instrument saved much manpower, however a technician or engineer was still required to read and record the readings displayed. To eliminate this requirement, the recording printer was developed for use with the frequency counter. This device prints, at any previously determined rate, the frequency read by the counter. The precision, convenience and lack of human error of these automated instruments leads to a great saving of engineering and scientific manpower in research and developmental testing.

While most amateurs would undoubtedly desire to possess such instruments, the initial cost and the maintenance required by such complex equipment would, in most instance, be prohibitive. However, all is not lost. The ubiquitous kit manufacturers have made available, at very reasonable cost, a wide variety of laboratory type test equipment. These instruments, for the most part, are adequate for amateur, experimental and routine production work. They fill a definite requirement for better performance than the common service equipment and sell at a price most amateurs can afford. Examples are the Heathkit laboratory signal generator, wide band oscilloscope and ac voltmeter which perform the same functions as their service instrument counterparts, but with increased precision and accuracy. While their performance may not equal that of the best commercial laboratory equipment, it is fully adequate for most purposes. Rarely are laboratory instruments operated in such a manner as to obtain the accuracy of which they are capable and, if this accuracy is obtained, it is often meaningless since other variables may well be the limiting factors.

Another category of kit laboratory type instruments permits measurement of circuit paramaters and component characteristics not measurable with equipment designed for the service industry. Examples are the Heathkit impedance bridge and the laboratory Q-Meter. Once again, these instruments are fully adequate for routine experimental and production work.

Used and military surplus equipment should not be ignored by the amateur interested in obtaining better than average instruments. The laboratory test equipment of the last decades was usually built to last a lifetime.



Ferris 'Microvolter' signal generator, completely rebuilt. A spray lacquer finish and commercial decals restored the instruments appearance.

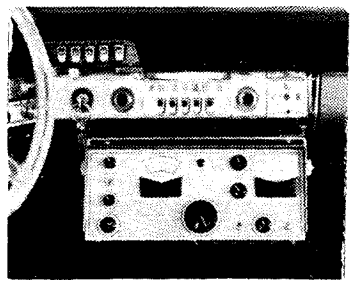
Simple circuitry, coupled with rugged mechanical design and precision components, resulted in equipment that was practically invulnerable to normal use and that would resist much actual abuse. Private industry, educational institutions and the Armed Forces are continually disposing of older precision test equipment and a wide variety is available to those who will search for it. Much of this equipment is in the hands of dealers and is often very reasonably priced. It is an interesting commentary on our present economy, but some of this used equipment is a bargain at the price it originally sold for many years ago.

Rather than wait for specific instrument requirements to arise, the amateur is advised to be continually on the lookout for the good buys and to purchase the more desirable equipment as it becomes available. It is axiomatic that the person buying to meet an immediate need will pay more than one who is able to wait and choose from the best as it filters into the market.

A few pointers are in order on the selection of instruments from those that may be found. Beware of paying undue attention to external appearance. Equipment being disposed of almost invariably suffers a period of neglect prior to disposition. Deterioration of the external surfaces is usually the first indication of this lack of care. Internal condition is of greater importance, since the instrument may be easily cleaned, polished and even painted if required. Of course if the equipment is working, try it out. Check operation, completeness and, if possible, calibration. Bear in mind, though, that an instrument displayed in working condition and inviting an operational check will usually demand a premium price.

The approach that has proved most feasible in the acquisition, rehabilitation and improvement of older laboratory test gear can best be illustrated by following through a specific ex-

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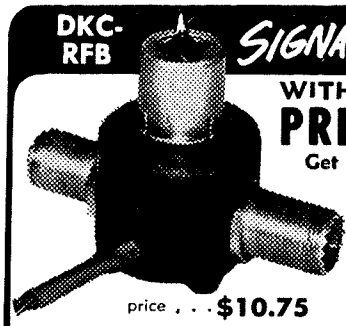
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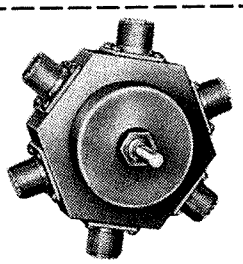
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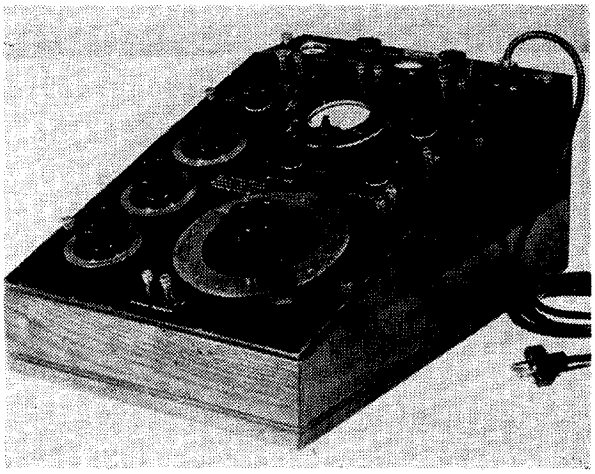


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The renovated General Radio Type 650A Impedance Bridge with the fabricated null detector-indicator installed.

ample. The writer had the opportunity to purchase a General Radio Company Type 650-A Impedance Bridge in what appeared, at first glance, to be in very poor condition. Since the price was extremely reasonable and a genuine and immediate requirement existed for such an instrument, the transaction was completed.

The General Radio 650-A Impedance Bridge is powered by self contained batteries and uses an internal galvanometer as null detector for the dc resistance ranges. The ac functions of the bridge use an internal 1000 cycle tone source but requires the use of an external null detector. Ranges provided are as follows:

Function	*Value*		*Accuracy*	
	Minimum	*Maximum*	*Maximum*	*Minimum*
Resistance ..	.01 ohm	1 megohm	1%	2%
Capacitance .	1 uuf	100 uf	1%	2%
Inductance .	1 uh	100 h	2%	10%
Dissipation factor	.002	1	5%	20%
Storage fact.	.02	1,000	5%	20%

The photograph shows one model of this instrument. It is well built, with a ¼" aluminum panel and is housed in a copper lined, mahogany case. The interior is typical General Radio quality, using solid bare wiring, large precision potentiometers and other components representative of laboratory instruments. Correspondance with General Radio disclosed that the Type 650-A Impedance Bridge was introduced in May of 1933 at a price of $175.00. At the time of its discontinuance in 1959, this instrument was selling for $285.00. It is interesting to note that, by building to the highest quality standards and by using simple, straightforward circuitry, this device could remain, relatively unchanged for a period of 26 years, the undisputed standard of the industry.

The Type 650-A Impedance Bridge was finally replaced by the Type 1650-A in 1959. This instrument is completely self contained, with internal batteries, transistorized tone source, null amplifier-detector and indicator. While the new instrument claims greater operating convenience, increased range and improved accuracy, the March, 1959 issue of "The General Radio Experimenter" noted that the fundamentals of good instrumentation still apply: "While specialized and unusual circuits often have advantages for single-purpose bridges, no satisfactory replacements have been found for the simple, classical circuits in a general-purpose bridge. Their accuracy and simplicity are difficult to surpass for direct measurements of inductance, capacitance, storage factor, dissipation factor, and both dc and ac resistance."

Inspection of the exterior of the instrument seemed to confirm a reported history of 15 years hard service. The panel paint was chipped and the aluminum eroded, the case was damaged and the dials were unreadable because of corrosion and dirt. The interior of the bridge told a completely different story. The typical General Radio odor, compounded of high quality Bakelite and honest rosin flux, was noted when the case was opened and appearance was as good as new. Although the lubricant used on the switches and potentiometers had hardened, there was no visible mechanical damage of any kind and a hasty continuity check disclosed no defective components.

The necessary cabinetwork was accomplished first. The instrument panel was removed, hardware stripped from the case and the old finish removed with paint and varnish remover. The case was sanded smooth, a coat of sealer applied and lightly sanded, followed by two coats of clear lacquer which provided a finish indistinguishable from a factory job. The handle was given a flat black lacquer finish and was installed, using new screws. New rubber feet, screwed to the bottom of the case, completed the cabinet.

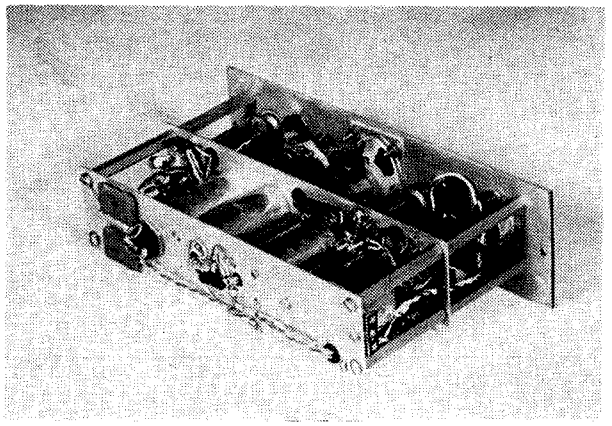
Next, all control dials, knobs and their associated hardware were removed and thoroughly cleaned in a solvent bath. Both the Bakelite and nickel plated surfaces were buffed to a high luster on a buffing wheel. Buffed coats of Simoniz restored this hardware to new condition. The instrument proper was then given the solvent treatment. Brushes and cloths were used to remove all traces of grease, dirt and corrosion from the panel and interior components. Extreme care was used to avoid damage to the fragile potentiometers and other parts. After the instrument was completely dry, contacts and moving parts were carefully lubricated with Vaseline.

The front panel now received attention. Corrosion was scraped from the panel where chipped paint had exposed the bare aluminum. Matching flat lacquer was carefully puddled into the resultant depressions in the wrinkle finish. After the lacquer was dry, two coats of Simoniz, buffed to a high gloss finish, com-

pleted renovation of the front panel. The knobs, dials and other hardware were then installed.

The completed instrument was connected to a battery source and a pair of headphones. A few quick checks showed that the dc bridge was operating properly, although no ac measurements could be made. Tests disclosed that the microphone hummer, identified as 0-1 in Figure 1, was not oscillating. Adjustment of the microphone button linkage restored its operation to normal and the bridge functioned on the inductance and capacitance ranges.

There is nothing sacred in the approach described above. Actual work required will differ in each case and there are many methods that may be used. Common sense, lots of elbow grease and careful attention to detail will lead to good results. The writer was fortunate in the example cited as no component replacement was required. Such replacements, if necessary, usually pose no serious problem. Rugged simplicity is the keynote in design of such equipment and repairs, either electrical or mechanical, are not too difficult. The increasing availability, from local outlets, of precision components in a very wide range of values, greatly simplifies such repairs. The occasional special part that is required may generally be obtained from the manufacturer and, while prices on these components are high, the value of the end product usually justifies the expenditure.



The impedance bridge power supply and amplifier-indicator unit. Note the extreme versatility of the 'post and plate' type of construction.

Once the equipment is restored to mechanical newness and the obvious electrical faults corrected, access to precision measurement instruments will permit adjustment of calibration circuits and verification of the over-all accuracy of the repaired device. All is not lost if you do not have the required instruments in your own shop. In todays diversified industry, it is not at all unusual to have a precision electronics laboratory just around the corner. Schools and other institutions also have precision measuring equipment which may be made available. Social contacts or a casual conversation at the local ham club will often

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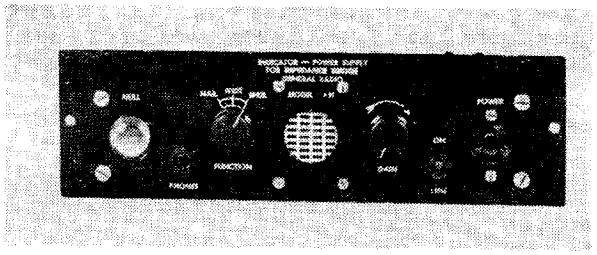
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This International Yearbook is published in England and regularly sells for 75¢. We have a few on hand for only 50¢, while they last. This lists ARRL countries, QSL bureaus, Propagation conditions world-wide, and all sorts of other data. From 73



The appearance of this amplifier-indicator assembly, ready for installation in the General Radio Type 650 Impedance Bridge, is enhanced by the use of commercial decals.

produce the required equipment.

Calibration of reconditioned equipment is not as difficult as would be expected. The calibration of most instruments can be restored to normal by calibrating at a single reference point for each range of the equipment. An example of this line of thinking may be cited by assuming a laboratory signal generator for which the accuracy of the calibrated output level is questioned. A resistance check shows that the step and variable attenuator resistors are near their proper values. Setting the calibration adjustment to produce a measured output voltage equal to that indicated by the attenuators, on a single frequency and at a single output level, will probably hold good for all frequencies and all output levels within the range of the instrument.

While the results that can be obtained with the older instruments have been covered, minor modifications and additional features can greatly enhance the value of such equipment. The General Radio Type 650-A Impedance Bridge provides a good example of this. While this instrument had been restored to its original condition, it still left something to be desired in operating convenience. Use of the internal batteries was expensive and presented a recurring maintenance problem. Headphones, used as the null detector, were awkward and were relatively insensitive.

The panel access battery compartment, measuring 6⅞" x 2¾" x 10⅞", provides sufficient room to install a low voltage dc bridge supply, selective audio amplifier, null indicator, loudspeaker and power supply. The photographs show assembly details of the added unit and its installation in the renovated bridge. The "post and plate" method of construction shown is ideally suited to modification work where available space may prohibit use of the conventional chassis and panel approach. This added assembly is shown as an example of a successful approach to instrument modification and the convenience of the self contained null detector and indicator more than justifies the cost and effort.

Basically, the circuit consists of one half of a 12AT7 as an input amplifier, followed by the other section of this tube as a phase-shift, selective feedback amplifier. Standard tolerance components are used to roughly tune the phase shift network to the bridge oscillator frequency and feedback is set just short of oscillation by selection of resistor "R". This stage is coupled to a 6E5 indicator tube for visual indication of bridge balance and to a 6C4 amplifier stage which feeds a small PM speaker.

Other categories of instruments may require different approaches to their repair and modernization. The end result of another renovation project is shown is the photographs. The signal generator is one of the family of "Microvolter" HF and VHF laboratory generators manufactured by the Ferris Instrument Corporation of Boonton, New Jersey. These instruments were used in great quantities during the last war and are widely available on the surplus market. The case and panel of this particular unit was in poor condition and complete refinishing was required. A spray lacquer finish and the use of commercial marking decals gave the instrument a "good as new" appearance. The rf section of the generator was in very good condition and the only work required was replacement of the output cable and cleaning of the band change turret and attenuator contacts. The power supply chassis was another story since all capacitors required replacement. Surplus, oil filled units were installed in the line filter assembly. New wiring was installed between the sub-assemblies. The unit was checked out and performance found equal to that of a new instrument.

This article has described the advantages that can accrue from the use of kit instruments and older, precision test equipment. It has further demonstrated how a laboratory may be assembled on a limited budget. Application of the techniques outlined herein should result in a high degree of success; broaden the experience and increase the capability of any amateur who enters into this field of endeavor.

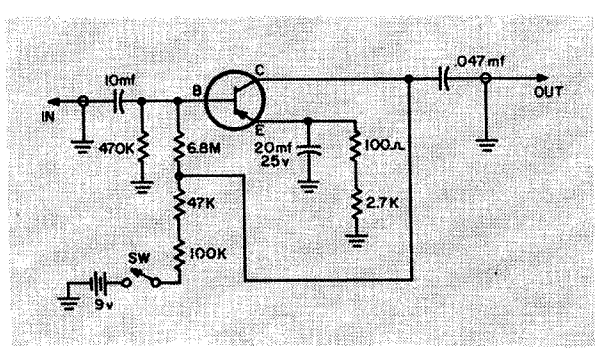
. . . Pafenberg

Letter

Dear Wayne,

The transistor mike preamp (p. 10, November 73) was rather interesting. Naturally I put one together to use with my Gonset II. I cut the distortion from 2.8% to about half of that by making a few small changes in the circuit, as follows:

LeVaughn Shipley K6CFF



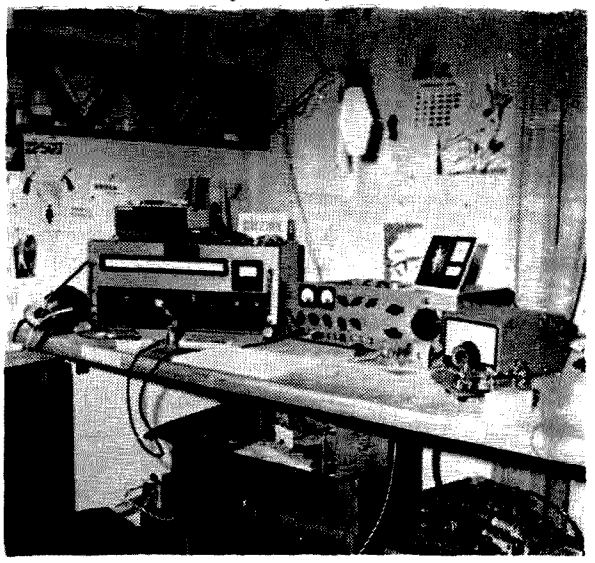
(Finland from page 19)

due to the fact that they *must* have certain number of CW contacts before they are allowed to pass the General Class examination.

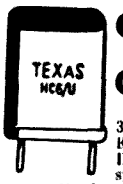
SRAL Board consists of the President plus nine members. SRAL Bureau has a regular personnel of one man (OH2XK) in full-day work, and the Secretary, Magazine Editor, Treasurer etc. just take their share of the activities in their 'leisure times.' Both in- and outgoing QSL cards are handled free of charge at SRAL QSL Bureau, all costs are covered by the annual membership fees. No economical help is received from outside. The annual budget is of a class of approximately $12,500 US, the membership fee being 2000 mk ($6) per year. The license itself, being valid for five years, costs 1100 mk ($3.40). In this connection it may be of interest to mention that in Finland every licensed amateur must be member of SRAL. This is a regulation of the Finnish 'FCC' (Post and Telegraph Ministry) and probably due to the control system.

Every day you may hear an OH on the air. Listen to the low end on 7 mc, or to the high end of 14 mc, always OH stations welcome calls from you. Don't ask us to teach you Finnish; it may be a bit difficult to you. Anyway, if you seriously want it, let's start right now: Here are a few words which you may use on the bands to surprise your Finnish friends. Hi! = *terve*!, Cheerio! = *hei*!, cuagn = *nakemiin* (a = .—.—.—), thanks = *kiitos*, many thanks = *kiitoksia*, and finally, when you take a drink and try to say "Prosit!", or "Rendez vous" or something like that, you can as well try to say it in pure Finnish: "hölökykölökyn!", but you must have something really strong in your glass then, hi. Just a declaration about a and ö letters: a, or "a with two dots" is pronounced like 'a' in the word 'mad', and ö like 'o' in the word 'work'. On CW they are as follows: a = .—.—.—, ö = — — — .

Hölökynkölökyn! 73! . . . OH2YV



One of the typical experimenter's ham stations. OH2MK shack is in the attic.



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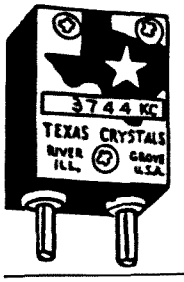
The following Class "D" Citizen Band frequencies in stock (frequencies listed in megacycles): 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225.

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W2SKE/MM [Mobile Motel]

Bill Leonard W2SKE

ADDING it up the other day, W2SKE's total operating time in the past two years came to just about 500 hours. But of this total, less than 200 took place from the home QTH. The rest involved temporary locations—more than 20 of them scattered across a dozen states and half a dozen countries. These temporary set-ups provided more fun and more memories than conventional hamming, perhaps because they offered something of a challenge. They meant not only operating, but 'getting on the air', as well. And as every ham knows, *getting on* the air is usually more fun than *being on* the air.

W2SKE operated from a hotel in the Chicago loop, from another in the Dominican Republic, from a fishing camp in Canada, summer homes in Long Island and New York State — but most often of all from motels. Motels of all sorts and descriptions and price ranges, motels perched on hills in the quiet country that might have been designed with ham radio in mind, motels dominated by traffic and noisemaking neon signs, motels in Miami and Tallahassee, San Juan and San Isidro, Des Moines and Dubuque, Hanover, New Hampshire and Avon, Connecticut, Boston and Los Angeles. The DX score from these one-or two-or three-night stands runs to something like 50 countries on 10, 15, 20, 40 and 80 SSB, in all countries. But much more important is the fact that with an absolute minimum of fuss and feathers one was able to stay 'in touch' with the gang or the family. A ham who travels as part of his job, or a ham who travels for vacation fun usually has more time for hamming 'away' than 'at home.' That's why motel mobile has meant so much to me. The trick is to make it—no pain, no strain. Here's how.

The requirements for 'motel mobile,' or any type of 'quickie portable' operation are (1) equipment that is small, light, easily packed, rugged and reliable, (2) an antenna system and equipment that combine to provide a station that will 'get out good' (it's just no fun to get on the air with flea power and talk only to flares), and (3) the station that is easy to put up and take down (a half hour or so to get going, and as much to pack up is all the effort a one-day stand is worth, but proportionately more effort can go into a vacation set-up).

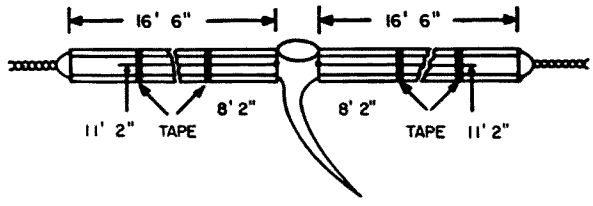


Fig. 2. The quickie triband doublet.

In these days of SSB and miniaturization none of the above is difficult. The author is fortunate in having a Collins KWM'-2 as his basic piece of equipment. Though this hunk of gear goes a long way in fulfilling the requirements above, it is by no means essential to 'quickie portable' operation. What *is* essential is a transceiver—or rather, a station that's all of a piece, *one* hunk of gear. No matter how compact the equipment, the process of hooking up a receiver and transmitter after lugging them around in at least two packages makes the whole operation more trouble than it's worth. The real secret in 'motel mobile' is that it *not* be 'more trouble than it's worth.'

So if you're building, build a transceiver, or a transmitter in a receiver cabinet. If you're buying, buy a transceiver.

Weight? If you do your travelling by car, weight's not the factor it is if your motel, hotel or camp is at the end of a plane trip. But, obviously it's just no *fun* lugging a couple of hundred pounds of gear in and out of a car. Besides, it clutters up that motel room. A fifty pound limit for everything, including spares, mike, antennas, etc., is practical.

Assuming then you have fifty or fewer pounds of dynamite. Assume you can unpack it and plug it in the wall within five or ten minutes. The only problem then is the skywire. And here's where experience pays off. The veteran motel mobiler knows that no two motels, like no two women, are exactly alike. He may or may not be able to drive around looking for the Ham's Paradise Motel (TV, Free Baby Sitter, Coax Outlet to 3 element beam in every room). Chances are he'll arrive in the gathering dusk by car, or taxi from the airport, and have about twenty minutes to case the joint and rig a skywire before the XYL and darkness descend. He must, therefore, be prepared! I always carry the following (in addition to a small, basic tool kit):

A 500 foot spool of wire (#20 or 22 enamel or bare copper).

A pre-fabbed 20-meter dipole, with small egg insulator at the ends, a small egg insulator in the middle, and 50-100 feet of RG58 U attached.

A small L-match unit (see later text).

A pocket compass.

4 *small* insulators.

1 roll of electrical tape.

50 feet of thin nylon rope or clothesline.

This combination is guaranteeed to get you on the air on at least 20 meters, and probably on all bands in very short order from any motel and from practically any *resort* hotel. For a mid-city hotel I have used the Mosley Tote-tenna with very good results.

Anyway, let's assume you arrive at Paradise Motel. Rule #1 is— case the QTH *before* asking for your room. Behind almost every motel there's a field. At the far end of almost every field there's a tree, a fence, or at least a bush. Try to get a room facing the field (second story if it's a two story motel). Visualize a long wire streaming from this room to that 'hook.' There may be several rooms in a row that 'qualify.' Ask for one of them. If there's no field or wide open space, chances are almost 100% there'll be a light stanchion, or telephone pole nearby. Get a room with clear line of sight to one or more of these supports.

What you have in mind—and what you'll be able to rig in almost no time in almost all motel QTHs is a *thin, random length wire stretched as far as possible, preferably in a favored direction.* Any wire 110 or more feet long at any height will, when matched, work on any and all bands from 10 to 80. The longer the better and the easier to match. Also—the longer the more directional, and the higher the band the more the wire will tend to fire off the ends of the wire.

The important thing—forget about pruning, measuring, or getting a 'resonant' hunk of wire. Practical considerations come first—run it out 'thataway' and let it go at that. Don't be upset if your hunk of wire averages only 6 feet off the ground. Just get it as high as you can. Use the hunk of clothesline or nylon line to help you get over the top of a tree limb. Hook the near (or motel) end to a nail, balcony or what have you near your room (through an insulator, of course). Run the lead-in through door or window sash into the motel room. Wrap the section of wire that passes close to the window or door jamb with plastic tape.

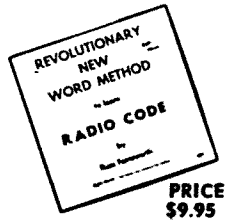
A few motels do not come equipped with built-in fields or woods. In that case forget about everything but 20 meters. String your readi-built dipole between two light stanchions, two palm trees, two balconies, or two blondes.

One other trick some of the motel mobile gang uses. Even those who don't go to the trouble of putting a mobile in their car will

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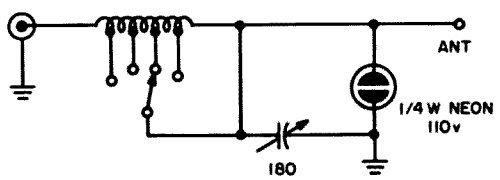
install a ham antenna on the family buggy. Then, when sack-down time comes, they simply run coax to the car antenna and away they go.

The random length of long wire across the open field is best. On the higher frequencies it exhibits real gain in favored directions. A length between 180 and 270 feet is ideal.

Some sort of simple coupler-matching device is almost always necessary in feeding this long wire into a pi-network final. It's probably a mistake to call this device an antenna tuner—it's simply an L-network for matching the relatively high impedance of the end-fed antenna down to the 52 ohm pi final. If all hams used long wires, pi networks could simply be designed to accommodate higher impedance ranges.

I have always used the Globematcher Jr. AT-3, a tiny little package with a neon bulb loading indicator and two controls. Proper loading on the final, coupled with maximum soup in the neon bulb indicates proper tuning.

If you want to build your own, the matcher looks like this:



The coil is a one inch diameter Miniductor, 25 turns with 5 taps at 2, 5, 10, 20 and 25 turns.

One other antenna has been used with success when operation above 20 meters was not desired. It is for use at locations where a long wire is not practicable. This is about the simplest tri-bander we know of. Take a 33 foot piece of twin lead, tie the ends together and attach two small insulators. Cut the twin lead wires at the center, insert insulators, and attach RG-58/U. Cut one wire 8 ft. 2 inches each side of center and pull off enough of the *outer* wire to reach up the half inch or so to the *top* wire, to which it is fastened.

Just one more step. Cut two 11 ft. 2 inch sections of insulated bell wire and lay them along the middle of the twin lead, soldering to the coax at the center, and securing them along the length of the twin lead every 18 inches or less with electrical tape. Reinforce the center section.

A low swr is obtainable on 10, 15 and 20 this way. Build and prune and tune *before* you set it out.

In summary . . . modern motels and modern ham radio make it possible to get on the air fast and effectively, and get *off* the air and ready to move on while the XYL is packing the unimportant things, like clothes.

. . . W2SKE

POSITION OPEN

Many people spend all of their lifetimes not working for ham radio magazines. This is a terrible waste. If our country is to really prosper we have to cut waste to the bone and trim the fat. Help America to prosper, work for a ham magazine. Perhaps you are worried that you do not have the proper qualifications to apply for such a position. Please check the following application blank and send it in immediately, together with the customary $3.50 job application processing fee. Your duties as a staff worker on the magazine will be to read each issue carefully, ignoring the gross technical mistakes that abound and to talk as many friends as possible into subscribing. A certain amount of time should be spent inducing advertisers to make more use of the 73 pages. Should these duties seem a bit harsh, we have a few supervisory positions open; however, the application fee for these is $6.50.

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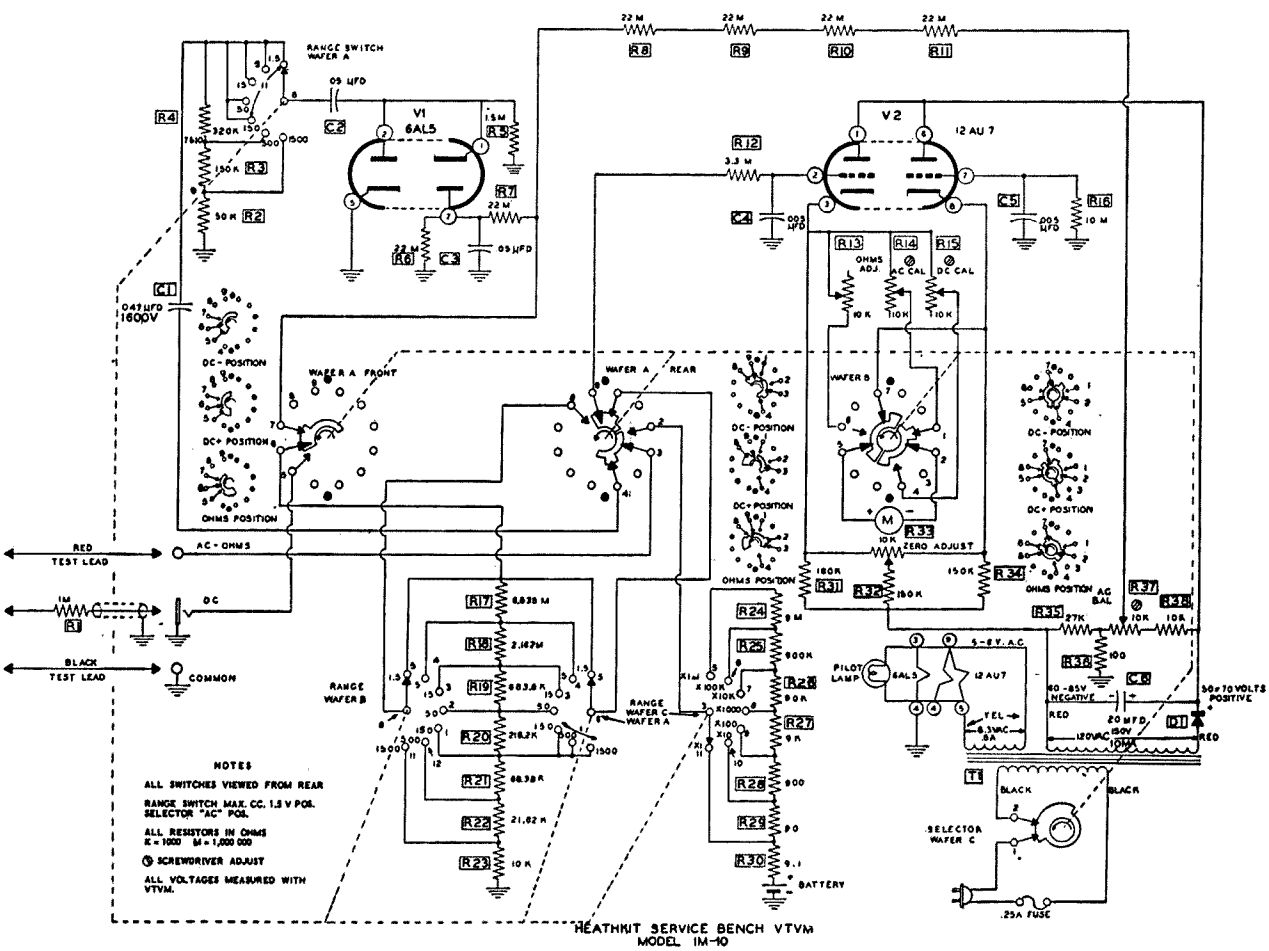
Donald A. Smith W3UZN
Associate Editor

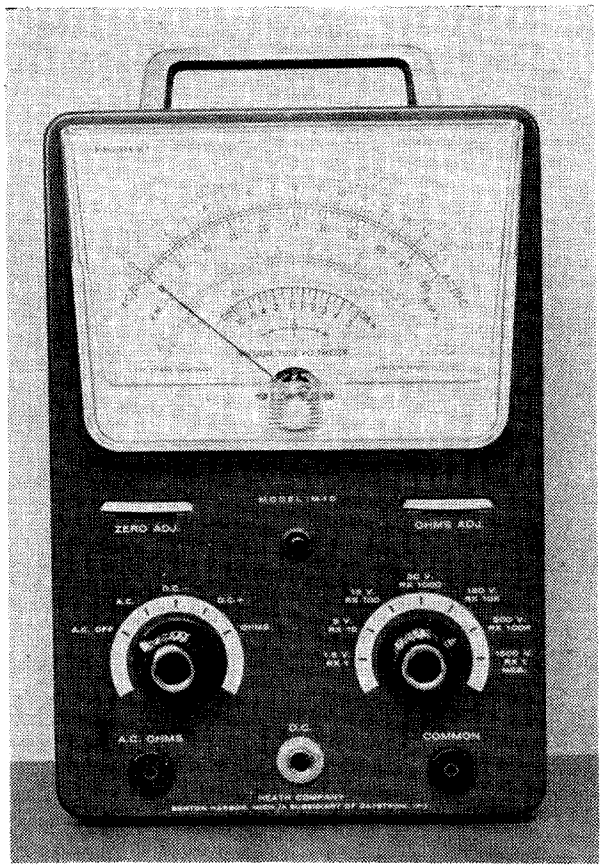
73 Builds and Tests the Heathkit IM-10 VTVM

HEATH'S new VTVM, though not strictly a piece of ham gear, none-the-less is equipment that no ham should be without. It's almost impossible to check out or repair a piece of gear without a good, reliable, VTVM.

The IM-10 has a number of features over its predecessor, the V7A. One of the most important, is the new 6" meter which really spreads out the scales. To make its use even more convenient, the scales are color coded. Zero and Ohms adjusts are thumb adjustments instead of knobs. Two new low ac scales have been added for more accurate measurement of low ac voltages. No printed circuit board is used in the IM-10, as it is in the V7A. 1% precision resistors are used as multipliers and the 6", 200 microampere meter has a full scale accuracy of 2%.

A dual triode, 12AU7 tube is used in a balanced-bridge circuit, with the meter reading any imbalance. With no voltage input to the 12AU7, as would be the case when not actually measuring a voltage, each section of the tube will draw the same current. The meter, which





is connected between the two cathodes, can not indicate any reading, as the potential of each cathode is the same. When a voltage is applied to one of triodes, one half of the tube will draw more current than the other, causing a difference of potential to exist between the two cathodes. In this case, current will flow through the meter because of this difference in potential or unbalance and the needle will indicate the amount of voltage in the circuit being measured. A zero adjust control is pro-

Heathkit VTVM....IM-10

Weight: 5 lbs
Size: 6½" x 9½" x 5" deep
Power: 105-125 vac 50/60 cy
Ohmmeter Battery: 1.5 v "C"
DC Ranges: 1.5, 5, 15, 50, 150, 500, 1500
AC Ranges: Same as DC
Ohmmeter: 1000 ohms (10 ohms center scale)
Multiplier: X10, X100, X1K, X10K, X100K, X1M
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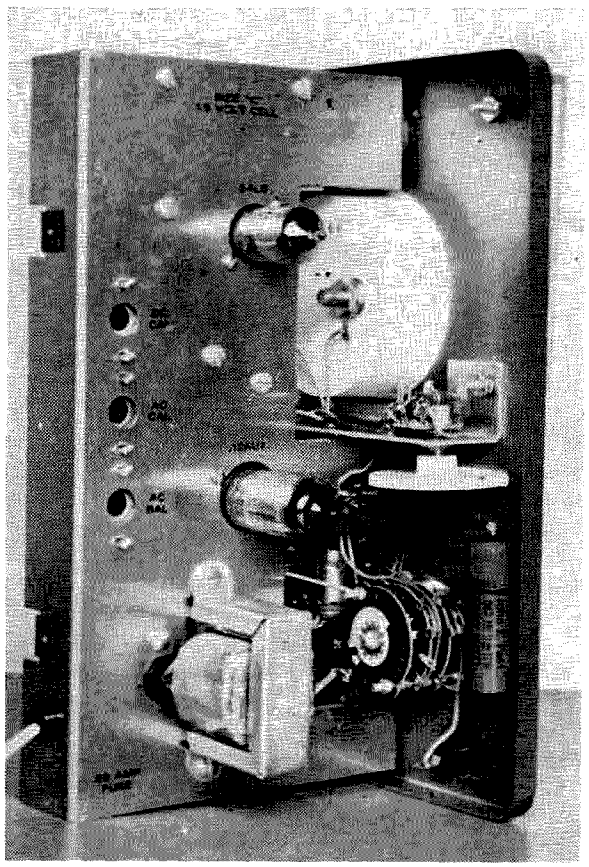
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ided to balance the current flow through one alf of the tube (no voltage being measured), o that both triode currents will be the same.

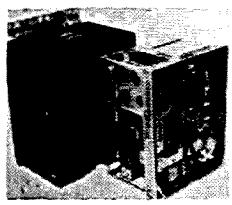
Of course not all voltages between zero and 500 volts can be applied to the grid of one f the triodes, so multiplier resistors are used ɔ extend the basic voltage range up to 1500 olts. These multiplier resistors are 1% precision resistors, as any inaccuracy in these resistors would be reflected in the voltage read n the meter and hence affect the over-all accuracy of the instrument.

On ac, operation is basically the same, except that a 6AL5 is used in a half-wave oltage doubler circuit and ac to be measured ; connected to it. When the ac voltage being ieasured is greater than 150 vac, multiplier sistors are switched in (by the range selector witch), to keep the input to the 6AL5 with-in :s rating. The output (dc) of the 6AL5 is roportional to the applied ac voltage and is nnected by the function switch to the dc ıultiplier section. Here the voltage is handled ı the same manner as when the instrument is eing used on dc.

The electronic Ohmmeter section of the TVM uses a 1.5 volt battery connected in ries with multiplier resistors as well as the sistance to be measured. How much battery oltage fed to the 12AU7 tube depends on e ratio between the resistance to be meas-ıred and the multiplier resistance of the ohm-ıeter section. Though the ohmmeter section oes have a battery, the instrument must still e connected to the ac line and turned on, so

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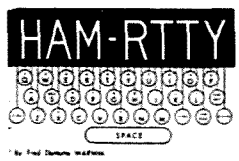
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RTTY Handbook



Since we have a new RTTY Handbook in preparation it is only natural that I should have quite an interest in the recent RTTY book put out by CQ and written by Byron Kretzman. I have to admit that they have done a nice job of publication . . . good paper, nice type. I am somewhat disappointed in the content. A great deal of the book seems to be lifted bodily out of the book that Byron and I put together back in 1956. Many of the photographs are the very ones that I took with my old Pony Premo #5 camera and several of the diagrams are the same ones that I originally drafted for my column in CQ back in 1952. It is nostalgic to read all of my own words again, lifted out of the old RTTY columns of eight to ten years ago. Though I have been relatively inactive in RTTY since becoming an editor, it is nice to know that I am still considered the authority for the field. Ha.

Work on *our* handbook has taken a lot longer than Byron's modified reprint of my old book. I've been out there with my new Rolli taking pictures of all my old and new TT gear. It is quite a job rounding up information on all the newer equipment and publishing an up-to-date handbook. I think you'll like the result. It has none of that text-bookish approach. It tells you the facts about what gear is best and what to stay away from. It tells you where to get the equipment. It tells you how to hook it up and how to use it. There are several types of converters, some with complete construction details. There are instructions on frequency shifting most commercial rigs. This is a practical book. Though the book was largely assembled by Fred DeMotte W4RWM, you'll find my light touch everywhere you look. Y'all better send in your order right now. Hear? $3, not $3.95.

. . . wayne

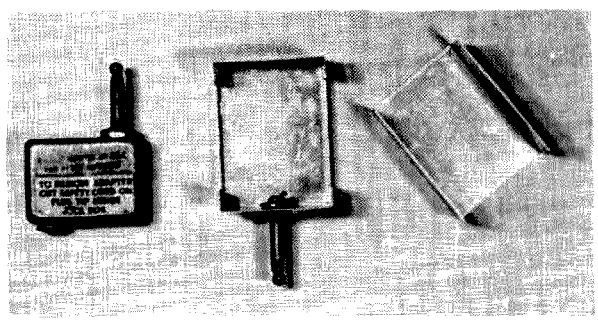
that supply voltage will be available to the 12AU7 tube.

Filament and B+ voltages are provided by an AC power supply and selenium-rectifier. A ¼ amp fuse is placed in the primary of the power transformer to protect the instrument. Calibration controls consist of AC balance, Ohms adjust, AC calibrate and DC calibrate. The meter can not be burned out in the circuit which is used, but it can be moved to the right so rapidly by incorrect settings so that the needle could be bent.

There is more than ample room in the chassis for all parts and wiring, which greatly simplifies building for the inexperienced. The manual is very complete, not only in the construction and calibration of the instrument, but also in explaining the advantages and uses of the VTVM over a VOM.

On any instrument which will be used to repair or adjust other equipment, plenty of time should be allowed for the building, testing and adjustment of the kit. If you can't trust your instruments, you really are in bad shape! No difficulties were found with the IM-10 and calibration was a snap. No special test equipment is required to do the job *properly*. I think you will agree when you finish building it, that it will be used more than any other piece of test equipment in the shack. With its large 6" meter, you can even read the scales at 4 a.m., blood shot eye-balls and all! . . . **W3UZN**

Chassis Mounted Phone Plug



An occasional requirement exists for a chassis mounted phone plug. Construction of station accessory items is often simplified if they can plug directly into the equipment without the use of cords.

The MC-385, high to low impedance headset adaptor is still available on the surplus market at give away prices. Certain models of this unit have a phone plug which is secured to the case with a standard ⅜" nut.

The plug is easily removed and can be installed as required. The photograph shows the adaptor, as supplied, and one application of the plug.

. . . W4WKM

Photo Credit: Morgan S. Gassman, Jr.

Commercial Notes

Irving Electronics surprised us with their new Hiverter and Preverters. Up 'til now Pappy has been taking it sort of easy down there in San Antonio turning out a whole series of printed circuit boards and kits. He has circuit boards available for almost every piece of ham gear ever written up using a board. Now, all of a sudden, he is making complete units. The Preverters are one band (six or two) transistorized preamps operating from 12 volts. These are obviously designed for mobile use and should meet a need for something to hop up the front ends of most of the commercial transceivers. The Hiverter is the answer to SSB on six meters. I know from my mail that a lot of fellows want to try SSB up on six, but not much has been available commercially to help them out. I've been after several manufacturers to get something out for this, so I'm happy to see it available.

The last time I decided to make a maximum effort to beat the ignition noise gremlins I found it a major job to locate the needed components. If it is difficult to do it here in New York where we are supposed to be able to find anything we need, I can imagine the problem a fellow would face out away from everything. Sprague has an answer to the difficulty, their new Suppressikit Type SK-1. This nets for $17.85 and is supposed to suppress everything below 400 mc! It works with either six or twelve volt systems. The kit comes with complete instructions and everything is ready to use.

While on the subject of cars. . . . I discovered that Bill Slep (ad page 85) not only does a lot of business with surplus down there in Florida, but has his finger in this electronic ignition deal too. He will have kits available for this before long. I'm looking forward to trying one on my Porsche. I'd better not tell the factory, they'd probably take a dim view of it. It looks good to me though and will be very simple to install. Bill seems to have quite a new idea there with his taking of surplus gear in trade for new ham gear.

(W2NSD from page 4)

quests for information. Whenever you write to a company that does advertise you might thank them for helping to bring you the magazine . . . and encourage non-advertisers to rework their ad budget to include 73. You'll notice that a couple of the major manufacturers in the ham field are terribly conspicuous by their absence. I don't know whether this is because they hate me in particular or whether they don't want to have their products associated with such informality as we sport here. It is probably more the former for I am basically pretty rotten, as should be obvious in my editorials by now.

Your local parts distributor could probably stand a little pressure too. This fellow should have 73 on his counter, carry a goodly stock of our HAM-TV book and our INDEX TO SURPLUS book. If he has enough ham trade to carry magazines and books, then he should be advertising a bit too. Maybe he isn't big enough for a full page, but how about one of those 2"ads? They are only a little over $25 a month.

I realize that these are a lot of things that I should be doing myself, but by the time Virginia and I get through sorting out subscriptions, reading articles, getting the magazine ready, calling advertisers for their promised ads, and preparing books, there isn't any time left to do anything else. Good grief, what will happen to everything while we're away for a month buzzing around Europe? We'll never catch up.

Reciprocation Again

Every time I talk to a radio club I ask for a show of hands on who has written to their Congressman about the Senate Bill 2361. So far I have seen one or two hands, and I get around to quite a few clubs. You can even add in a couple of conventions that I have addressed without getting much more of response. This is very discouraging. Perhaps I am over emotional about this, but I feel that our showing on this matter is a key to our whole attitude toward the hobby. A lot of fellows are participating in ham radio without giving the hobby any personal support. They seem to feel that once they've subscribed t QST they have their own obligation out of the way.

If we allow this bill to die in committee



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without any attempt to administer artificial respiration then we deserve everything that I believe will happen to us as a result. First and foremost we will find that the indignation of the DX hams is high when we have gone so far as to have a bill sponsored and then permitted it to die in committee. Almost every foreign amateur in the world feels a personal interest in this insignificant piece of legislation. Under our present rules no foreign amateur can get permission to operate while visiting the U. S. Senate Bill 2361 will change this to permit the F. C. C. to permit foreign licensed amateurs visiting the U. S. to operate, providing there is no possible question of security.

In many foreign countries quite a few of the amateurs are high in the government or leaders in business. Many of them swing a lot of weight. At international conferences on radio we find that an extraordinary number of the delegates turn out to be amateurs. These are the chaps that will be deciding in a couple of years just how the amateur bands are going to be re-allocated. These are the chaps who have occasion to visit the U. S. frequently and are prohibited from getting on the air during their visits to talk with us as locals and to talk home to friends.

If I tell you what I think may well happen at the next Geneva Conference you will dismiss me as an alarmist and heretic. Other magazines will editorialize on my "scare techniques" and so on. I think I know what I'm talking about and I have yet to meet one responsible ham who is in touch with current events who thinks any differently than I. The last conference taught me a lot, and little of it had any soothing effect on me as far as the brightness of our future is concerned. I feel that any amateur who has an interest in his hobby has a duty to write a letter to his Conggressman asking him to support Senate Bill 2361 and help get it out of committee.

If we should fail in this effort then we will be branded as ineffectual and we can be walked over by every other interest who covets our frequencies. Where will such a demonstration of weakness get us when the Citizens Banders get a lobby in gear asking for more CB channels? These fellows already outnumber us by two-to-one. We lost Eleven meters to them even when we had them outnumbered. If you don't start writing we're sitting ducks.

Speaking of lobbies, how come we don't have a small group (even one man) down in Washington on a matter as vital as this? As I have said before, even one man could probably get this bill over the rough spots. If no amateur organization has a man free for the job, what about our manufacturers? Don't you fellows care what happens to the ham market in three or four years? You're selling about $30 million worth of gear to hams a year, put a few hundred into keeping us going even if we're too busy talking on the air to drop a line in our own behalf. Have your rep in the Washington area check into things and push a little where it will help.

End of tirade.

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Books & Booklets

Some time ago I editorialized about our publishing some small books and booklets. The response was rather good to this suggestion and we are now in the process of publishing the first of these. Our HAM-TV book doesn't count on this because we started work on that over a year ago. One of our first books under the new plan is the Index To Surplus by W4WKM. This is a prodigious effort by Roy and lists every surplus conversion article ever published in any of the popular radio magazines or con-

(W2NSD from page 87)

version manuals, along with a brief description of the conversion.

This book just came back from the printer and it is one I'm proud of. Everything went well with it . . . the print job is first class, the cover looks nice, and we have found no mistakes in it. This will be available through 73 directly, from Radio Bookshop, and should start appearing on the counters of the parts distributors soon. In particular I expect that surplus dealers will be wanting to sell this gem.

Fred DeMotte W4RWM of the Florida RTTY Society is putting the finishing touches on the new RTTY Handbook. Fred wanted to finish it earlier, but I held him up in order to get in some last minute commercial equipment. I also wanted to wait until CQ brought out their recently announced RTTY book to make sure that we covered everything that they missed. I'm happy to report, after seeing the CQ effort, that our book is much less textbookish and is written from the practical application aspect rather than the heavy theory angle. I suspect that most TT devotees will invest in both in order to have as full a library as possible.

Carole Hoover K9AMD and I talked over the booklet idea out at the Springfield (Ill.) convention last year (where my transistor radio was stolen from my room at the St. Nicholas Hotel). Carole followed my suggestions and has done a magnificent job of preparing a booklet on ham radio clubs. She went into a lot of research, writing to dozens of ham clubs and interviewing hundreds of ham club officers to find out what aspects were important to the survival of a ham club. Her booklet, well illustrated, is now available under the title, "The Care and Feeding of a Ham Club." This booklet is not only interesting reading for everyone, but will be invaluable to all hams who want to help their own club grow and prosper.

K8LFI, one of our regular authors, sent in a manuscript recently that was much too long to publish in 73. I suggested that we put it out as a booklet and Bill went along with the idea. This one is called, "Simplified Math for the Ham Shack." This is the best math article I've ever seen and it makes the whole process quite simple. I know that a lot of people have a great fear of math. This is a shame, for once brought out of the school book and given the breath of life the subject is simple and interesting. Bill is a wonderful explainer and he leads you gently from one step to the next, covering the whole subject with expert finesse.

What with trying to get 73 ahead enough to let us go to Europe for the month of April, it is incredible that we should also be able to produce even more booklets. WϕOPA sent in a piece on the "Mickey Miker" which just had to be published. Again it was too long to print in 73 unless we chopped the daylights out of it. This is now a little eight page booklet. Harvey gives exhaustive details on the building of this fine piece of test equipment which will measure capacity right down to the fraction of a mmfd.

K8BYN sent in a fine piece on coils. I've long felt that there was a need for a basic series of booklets on radio. This one does a wonderful job of explaining about all the various types of coils that are used in radio construction and is magnificently illustrated.

As more book and booklet manuscripts come in we'll be publishing more booklets. I am quite sure that we are giving the best deal by a very

(Turn to page 90)

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(W2NSD from page 88)

wide margin to all authors of books. For that matter we are giving the best deal to all authors in 73 too.

Look over the list of booklets and stint not.

Write

If you've been reading the editorials at all it should come as no surprise that Virginia and I are leaving for Europe on April first via Lufthansa chartered jet. The Porsche Club of America is sponsoring the trip. As you may know, a charter flight costs less than half of the regular tourist class fare. We will arrive in Stuttgart on the second and be driven to Solitude Castle where all of the new Porsches ordered by the club members will be spread out on the huge lawn. Among them will be my old 1958 Porsche Speedster which I shipped over in January to have reconditioned.

I was all for ordering one of the nice new model Porsches, but Virginia pointed out that we are much too close to pauperism to even consider putting a down payment on a new car. Practical gal.

You're probably getting pretty tired of hearing about Porsches all the time, perhaps I'd better explain. All Porsche owners are absolutely certain that the Porsche is the finest car in the world at any price. Dr. Porsche was a fanastic genius and is responsible for many of the best features of todays cars. He designed the little VW. He thought up the flat opposed piston air cooled engine which makes the VW (and Porsche) so unbeatable. He invented torsion bar suspension, synchromesh transmission, and was one of the first designers to streamline cars. There are whole books written about the amazing works of this man. His masterpiece is the Porsche car. If you follow sports car racing you know what successes Porsche has had.

Several European amateurs have written and I've set up a fast schedule of talks during my trip. The exact route is: Stuttgart, Munich, Innesbruck, Venice, Florence, Pisa, Genoa, Milan, Geneva, Bern, Luzen, Zurich, Frieburg, Paris, Luxembourg, Heidelberg, Darmstadt, Frankfurt, Berlin, Frankfurt, Wiesbaden, Nurburgring, Bitburg, Koln, Mulheim, Arnhem, Rotterdam, Amsterdam, Hamburg, and New York. It sure would be fun to get a card or letter during the trip from any of you that care to write. You can write to me in care of American Express, Paris, France where I will pick up all mail on the 14th of April, or American Express, Berlin, Germany on the 19th. Airmail letters take about four days, so leave time. Airmail is 15¢ to Europe, but I'm not worth it. May be a QSL, at least?

April Last Year

The April 1961 issue of 73 was quite an issue. We still have a few left in case there was something you missed in it. The most interesting article (according to reader votes) was K8BYN's Six Meter Nuvistor Converter. This unit used two 6CW4's in cascode and resulted in a very low noise figure circuit. K8ERV came up with a dummy "next stage" device, a continuous tuning link coupled absorption wavemeter with a loaded and metered rf indicator. W4WKM has an article on how to protect silicon rectifiers in case of a shorted capacitor. K4ZGM's Let's Modulate, Not Crepitate explores Heising modulation . . . rather successfully. Jim Kyle K5JKX has a new noise limiter circuit for us. Many readers

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ave written in telling us how well this one orks and recommending it. W4WQT writes out the importance of calibration. W6VVZ's P 304TL gallon final may not be new, but it es show us how to get maximum power conomically. K2SJN comes up with all of the nswers TVI committee needs to handle the ifficult cases. W9IIOV (Gain, Inc.) presents chart of the lengths of ½ wave, ½ wave oax, ¼ wave coax and 4½ waves for the ifferent ham bands. K8HDR came up with a ever method of getting a lot more audio out the Command Receivers KL7DLC sold a lot the April issues with his transistorized 40 tt modulator. Great for mobile operation. 3UZN tested the Heath Twoer for us. Bill shby K2TKN had a fine article on noise ppression. Our big technical article for this onth is on *if* selectivity and it covers ceramic ters, Collins filters, crystal filters, lattice ters, Q-multipliers, L-C filters, Q-5'ers, etc. o cap the whole works we have an article on ow to write for 73 and get rich beyond your ldest dreams. While they last they are 50¢ ch.

Reader

Shortly after the March issue of 73 was ublished I got a frantic phone call from E.G. Sales. It seems that Sam has thousands those FL-8 and FL-5 filters on hand and is lling to force himself to part with them at low figure ($2.49). I believe you'll find more tails on this situation back on page 94. In ecking the fantastically complete list com- led by W4WKM and published by us under title of Index to Surplus ($1.50) I find e other references to FL-8 and FL-5 icles. The most important is the one I pub- hed in CQ in November 1957 wherein you achieve almost unbelievable selectivity th cascoded FL-8's.

Oh Rally?

A letter from KZ5SW Ted Wilds asks, Where . . . was the rig in your Porsche? I dn't see it in the photo in Foreign Car Guide. here was a lot of other expensive equipment." ok closely Ted, down under the dash is a anscon-6! This makes the dozenth maga- ne to print this picture of the most acces- ried sports car ever seen. This is the cockpit my 1958 Porsche Speedster, all duded up r rallying.

hat's a rally? Where've you been! A rally a completely non-ham radio event (which s no business in 73, except that it is an en- usiasm of the editor and sometimes you have take the bad with the good) primarily of terest to sports car addicts. Most sports car ubs put on several rallies a year, and they about the only source of rallies. In a rally have a driver and navigator. You are ven a set of instructions and started out one minute intervals. The object is to fol- the instructions as closely as possible, ping on the roads specified and driving at

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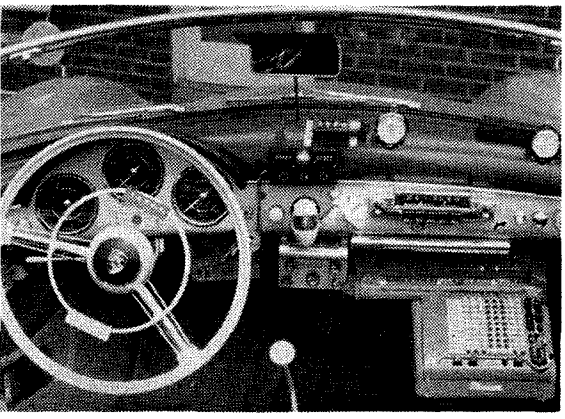
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(W2NSD from page 91)

specified speeds. Every so often you will ne across a checkpoint where you are timed. ey know exactly what time you should pass point and you lose points for every second ly or late there. It takes great attention to ail to consistently win these events.

Many hams have been attracted to rallying. is a rare Sunday rally in this area that es not see at least a half a dozen hams par-ipating. Harold Winston W2DIR, who irted rallying about two years ago, is now esident of the Town & Country Sports Car ub. This is remarkable when you consider at he drives a Desoto! I notice that old end Bob Schoening WØTKX is high on the CA rally list for 1961. Porsche driver. Most





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of the gang up at ARRL HQ are rallying these days and now and then one of them ventures down this way to compete.

There is something fascinating about striving for absolute perfection for from three to five hours. Everything fights you. It takes many days to adjust a stopwatch to hold its time to the quarter of a second over a period of hours. All through the rally we tune in CHU on 7335 kc and make sure that the watch is still accurate. Even with an electric odometer you have to be very careful to measure your mileage to the half a hundreth of a mile (25 feet). Every time you have to speed to make up time for a wrong turn your tires get warmer and expand and you have to allow for this. Both driver and navigator (Virginia) are kept busy every minute.

You've got a lot of writing ahead, you'd better get started. Write our advertisers, your senator, CQ for my slides, and don't forget to drop me a note in Paris or Berlin.

Wayne

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National's NC-270 proves itself the *only* way — in actual performance on the lab bench and under adverse operating conditions in the field. CQ and QST experts gave the NC-270 truly remarkable reviews. Of equal importance — letters from amateurs all over the world cite astounding performance under almost unbelievable receiving conditions.

FROM QST — JANUARY 1961

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FROM CQ — MAY 1961

" . . . retains all the "feel" of the more expensive receivers for which this company is known . . . It is unusual to see a front panel NOTCH DEPTH control in this price class . . . The a.n.l. circuit in the NC-270 is exceptionally good . . . Mechanical stability is impressive. It is possible to tune a s.s.b. signal on one of the high frequency bands, lift the front of the receiver up several inches and let go. Unless the main tuning knob moves, the signal will still be there . . . (The National NC-270) is an extremely stable and sensitive receiver . . . "



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AMATEUR RADIO

73

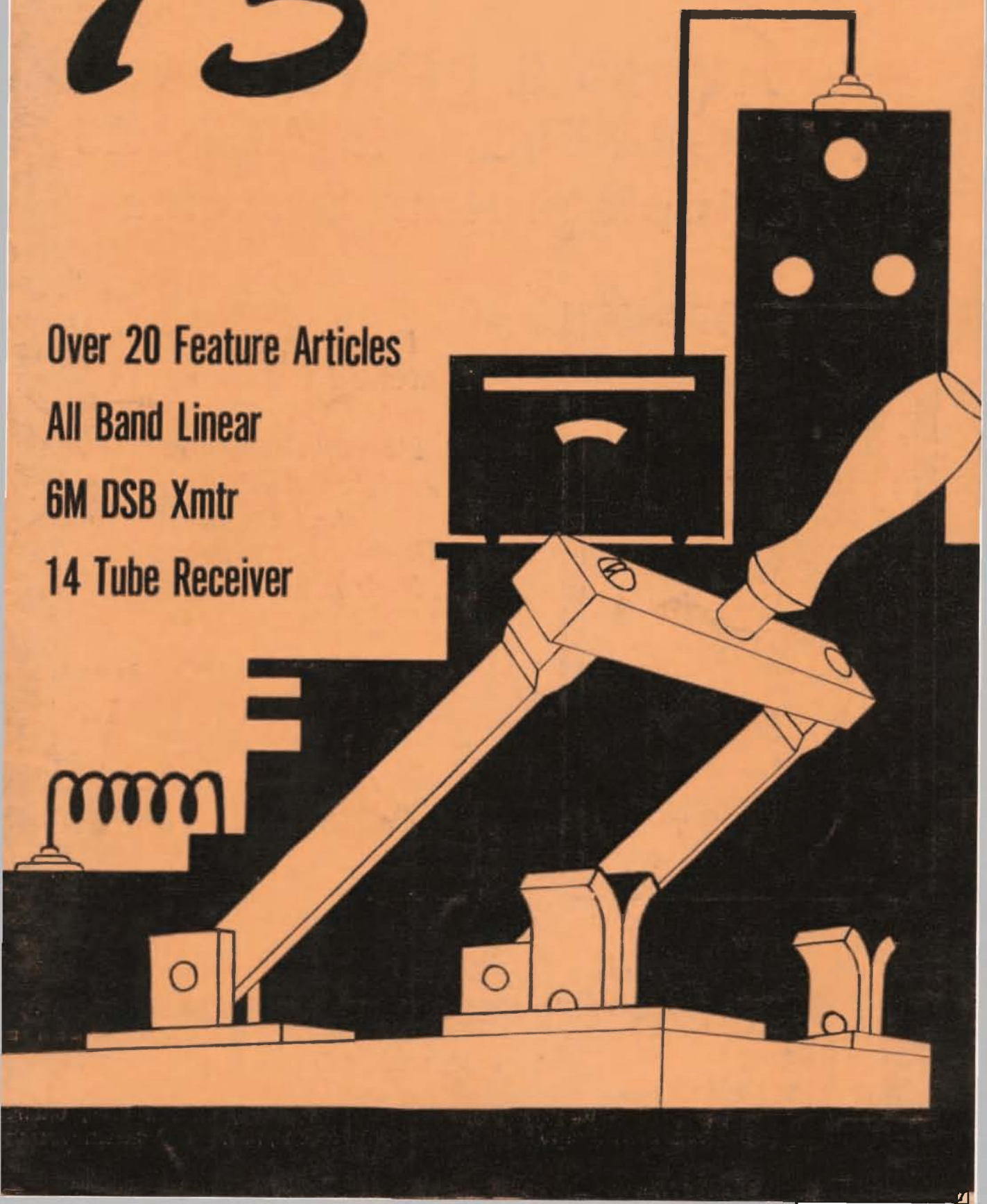
May 1962
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Over 20 Feature Articles

All Band Linear

6M DSB Xmtr

14 Tube Receiver



73 Magazine

May 1962 • Vol. VI, No. 1

1379 East 15th Street—Brooklyn 30, New York

Wayne Green W2NSD—Editor, etcetera

Phone: DE 6-8880

Two Meter Tank and Coupler ..... John Wonsowicz W9DUT 6
Part I on a marvelous two meter rig.

Simple Antenna Mast ..... Jim Cannaliato K3LTB/5 8
22 Feet for $4.00.

6M Double Sideband-AM Transmitter ..... Fred Cupp K8AOE
Uses circuit board. Whole bunch of fellows are getting on with this simple rig. John Yeagle K8MSB 10

Twoer Modifications ..... Ernest Wolitzer K2ORY 16
AC/DC power supply, new osc. circuit. Applicable to 10'er & 6'er too.

73 Tests the Telco 201 Converter ..... Larry Levy WA2INM 18
This six meter nuvistor converter is amazing.

ARC-5 VHF ..... Charles Sizer WA2FHC 20
Inexpensive surplus rig auto-tunes to 6, 2 and 1¼ meters.

73 Tests the Clegg 99'er ..... Bill Pasternak WA2HVK 22
Everybody probably already knows that this rig is great.

7077 Two Meter Converter ..... John Dillon WA6EWV 24
73 is first again with an application of this new ceramic tube.

Four Layer Devices ..... Joe Crowling K4CPR 30
Keeping you abreast of fast moving developments in solid state gadgets.

A New Broom ..... Dick Gridley K6JHJ 32
Sweep generator for aligning filters and stuff.

All Band Linear ..... David Gauger W9CJS 34
Using four EL-34's (those hi-fi tubes). 300 watts.

FSK Without Relays ..... Ted Hart W5QJR 38
Diode keying unit replaces polar relays for the RTTY group.

Do Hams Have Fun? ..... Conway Wilson W4WQT 40
You'll have fun with this one.

Receiver Prices ..... Bob Kuehn WØHKF 46
Original prices and dates on old receivers. Nostalgia. Inflation!

The 85 B.14 Receiver ..... William Bernard 50
This receiver should keep you out of trouble for this month.

Vacuum Capacitor Traps ..... Charles Spitz W4API 60
Surplus vacuum condenser units for multi-band traps.

Budget VTVM ..... Ken Matsen W7INX 62
Easy to build gadget. Get out the soldering iron.

Notes on Silicon Rectifiers ..... John Wait K5IPY 66
We'll have to start a silicon rectifier department soon.

73 Tests the Heath HA-10 Linear ..... Al Brogdon K3KMO 68
Another Heath rig proves out FB.

Complete Fire Insurance ..... James Lee W6VAT 70
Or, how to keep your transistors out of the garbage.

73 Tests the Knight RF Z Bridge and Pocket VOM ..... Larry Levy WA2INM 74
For $5.85 and $9.95 you sure don't go wrong.

73 Tests the Hallicrafters HT-40K ..... Don Smith W3UZN 76
New kit from Hallicrafters.

Propagation Charts ..... Dave Brown K2IGY 78
What time to where, when, on what band . . . probably.

RF Q Multiplier ..... Gus Gerke K6BIJ 80
More fun with the 2N169A.

High Power Antenna Switching Unit ..... Roy Pafenberg W4WKM 82
Using one of the ART-13 antenna switching units to good effect.

A Cheap, Simple, Plate Modulator ..... Gary Stock WA2PGX 86
The surplus Command Set MD-7 is cheap and works fine.

Keep Your Key from Crawling ..... Howard Pyle YB of W7OE 89
Without bolting it to the table.

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. . . de W2NSD

. . . never say die

Awards

A letter from OH2YV got me to mulling over the part that Certificates and Awards play in our hobby. Somehow I had never really thought about this before. Like many other fixtures of life I just accepted them as being there. Now I've begun to realize how much these things actually dominate ham radio.

What would operating be like if there were no awards? Would it then be possible for a DX station to get on the air and have a half hour contact with us without being hounded by hundreds of DX-hunters, all driven by their DXCC listing? Would not the now familiar snappy 30 second DX QSO be a thing of the past without the pressure of these awards? Might not DX operators assume identities instead of just being call letters to us if we had an opportunity to talk to them about anything other than their QSL and our QTH? Maybe not. Maybe we would keep on trying to work more and more DX stations even without the monthly ARRL treadmill of newly invented countries.

Since there is absolutely nothing that can be done about this to change it or to rescue those operators who have turned their whole lives over to staying high on the "list" perhaps I would do better to peck at the fringes of the problem. The Certificates Industry has gotten way beyond the ridiculous now with over a thousand being available. Almost every day I get in a sample certificate from a club or group of operators, adding to the toppling pile. Is there anything we can do to bail ourselves out from under this growing mountain?

One solution is to take up arms against this thing and fight it at its source. You can lean (through the mail) on the amateur publications and make them stop giving free publicity to these awards. This will quickly stunt the present runaway growth of this nuisance. Perhaps we should form a Certificate Haters Club (CHC) and have our own Certificate?

Perhaps I am too reactionary. Maybe we should just try to clean house a bit and settle down with a dozen good internationally acceptable awards to go after? It may be that I will stir up a hornet's nest with this attack on so fundamental a part of our hobby. I know that hundreds of operators are all hung up on awards and are certain to be pretty emotional when something so dear to their heart is treated like this. Should such a sentiment develop I believe I am ready for it. I have for some time been working on a fabulous award to be made available by 73 Magazine. This award is one of such scope as to placate the most irate certificate hunter. Aha, I think I've got you trapped . . . you want to know more about the Award To End All Awards. Let me tell you about it.

A few months ago I read with incredulity about a newly proposed award which would encertificate people on the basis of the number of counties they contacted. My first reaction was that this must be a joke. Then, when it was obvious that this preposterous thing was being seriously proposed I felt sure that everyone would just give it the horse-laugh and it would die a natural death. Alas, I did not reckon with the effectiveness of modern advertising, which was able to whip a shuffling sort of life into even such a Frankenstein as this. My sporting instinct was aroused. I would concoct an award so unbelievable that no amount of advertising would be able to get anyone to take it seriously.

This one would be an award to dwarf my previous successes in the certification field which reached such minor pinacles as the resurrection of the WAZ award, which I saved from premature extinction in 1955, the almost forgotten TT-100 for RTTY'ers who contacted 100 other RTTY stations, the still going (I think) sideband country awards for SSB-50, SSB-75, SSB-100, etc., etc. Possibly my best effort to enslave the certificate seekers was the WPX award, complete with its own record booklet, a nice little money-maker. With this background, how could I fail to come up with a new winner?

The new award would have to be one which would be accessable to every licensed amateur. It would have to be one which would have many facets to suit the varied operating interests which go to make up ham radio. It would have

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May 6—Rectifiers for Amateur Radio Power Supplies.

May 13—Presentation of the 1961 Edison Radio Amateur Award.

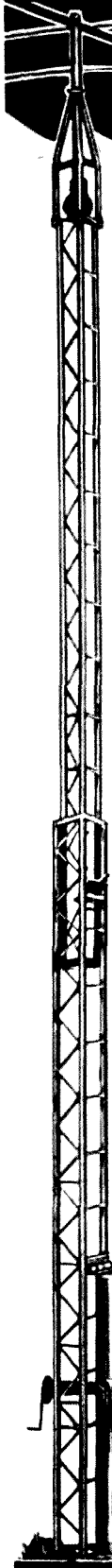
May 20—Novel Equipment for the Mars and Amateur Radio Station.

May 27—Applications of Drift Transistors to Radio Receivers.

June 3—Transistor Multivibrator and Logic Design Considerations.

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to be universal and not discriminate against anyone on the basis of color, creed, or lack of intelligence. It would have to take into consideration that QSL's are almost impossible to depend on for confirmation. And still, with all of these seeming limitations, this must be an award of heroic proportions.

I hope you haven't sold me short. I have devised an award which is awe inspiring in its scope and which overcomes all of the previously mentioned limitations. It also satisfies several obvious but unmentioned prerequisites such as requiring a record booklet which we can sell at an enormous profit and having a nominal charge for the certificates which may eventually support the whole magazine and allow us to give 73 away free to all winners for life. Details on this magnificent award will be announced in an early issue of 73, in the meanwhile I suggest that you get on all bands and contact as many stations as you can, making each contact a minimum of 30 minutes (GMT) long. Neatness counts.

The Old Man

Perhaps I am just too inculcated with ARRL lore, but I bridle every time I see someone trying to call himself The Old Man. This title should, I think, be reserved in perpetuity for Hiram Percy Maxim, the founder and long time leader of ARRL. I, for one, would welcome an occasional reprint of some of Maxim's old editorials. He was an excellent writer and I doubt if the years have weakened his messages much. Those of you with library cards can look up his wonderful book "A Genius in the Family." This, to me, is one of the all-time greats in humorous writing. Is anyone with me for keeping ham radio with just one OLD MAN? Or am I out here all alone on the high end of twenty with the band closed?

Technician

Volume 1, Number 2 (the first I've seen) of The Technician came in the other day unheralded. This is a nicely done bulletin and is interesting to read. The price is $2 per year and it comes out monthly. Write to The Technician, Box 465, Billings, Montana. The motto of the bulletin seems to be, "I'm proud to be a Technician."

May Last Year

Though we were still running only 64 pages last year, we made up for the shortage of paper (due to a lowness of advertising) by running quite a lineup of good articles. We still have a few copies of this choice issue available at 50c per.

The most popular article in the issue was the extremely simple sideband exciter by W2NQS. This one uses a pair of the 7360 tubes and almost everything is built on a couple of vector type sockets. W8VVD's article on his

(Turn to page 92)

2 Meter Tank and Coupler

John Wonsowicz W9DUT
4227 North Oriole Avenue
Chicago 34, Illinois

All pictures taken by Howie Trieb KN9EBP.



Photo showing the "Echo" 144 meter transmitter using this High Q Power Amplifier.

THE tank circuit about to be described is not new. It was used by the author on 112 mc more than 15 years ago. However, the merits of this tank warrants the re-use of this design in the higher frequency spectrum, even above the two meter range.

As shown in the photo and drawings, the tank was designed for the 832-A, but other tubes such as the surplus 3E29 or its equivalent 829B can make use of this design by cutting down the tuning capacity and shortening the inductor. The unit is easy to build, requires no soldering, and can be made in L C ratios to meet individual designs. Q of this circuit is very high; being comparable to tuned lines of 7/16" in diameter.

Those of you that like to make Chinese copies will have to resort to modifying the tuning capacitor as indicated. Others, who like to roll their own, from start to finish, can use the basic idea for further development and improvement of such circuits. Space for this tank is no problem since the aluminum horse shoe can be bent to various configurations with little sacrifice in efficiency.

Tuning Capacitor

The capacitor used, which by the way is the only one suitable for this design, is a Hammarlund MCD-35-SX double spaced dual stator variable capacitor. It is a straight line capacity model with maximum capacity of 31 mmfd. This capacitor can be used, and was used without modification in a 144 mc transmitter with a smaller horse shoe tank but for best L C ratio and ultimate efficiency it should be modified by removing plates which is quite simple. Using a small metal coping saw or a hacksaw blade cut away the two outside plates of each stator, then using a fine file smooth out the solder burrs on the shaft and file off all rough edges around the cuts. The capacitor is now duplicated.

Inductor

The horse shoe inductor is made of 1/16 inch aluminum plate cut to dimensions, as shown on the drawing. Follow the dimensions closely; however, the finished project doesn't have to be exact since the above mentioned capacitor enables some overlap of the 144 mc band at both ends. When the inductor is cut out and the saw marks are filed smooth, use a fine texture of steel wool for polishing and rounding all sharp corners and edges. Due to surface currents in VHF region, known as the skin effect, it is worth the effort to do this bit of extra work for the sake of higher efficiency. Of course if you want the ultimate, the inductor could be made of sheet copper and then silver plated; but for the average ham the aluminum tank is quite satisfactory.

When the inductor is finished, slide it under the stator plates by loosening the four screws on the bottom of the ceramic base. Before tightening the screws, cut two ribbons ½ inch wide out of aluminum foil, or copper ribbon, to dimensions indicated on the drawing and insert them under the stator plates at the opposite end of the horse shoe tank; then tighten the screws, making it a complete assembly as shown on the photo. Before you set aside this unit be sure to elevate the front and back bearing plates of the tuning capacitor by removing the screws and inserting shims under each of the same thickness as the inductor. Otherwise the minimum capacity of this unit will be too high and reaching the high end of two meters may be impossible.

Plate Caps

For the tube pin connection, a piece of ½

inch round aluminum stock is cut ⅜ inch long and a No. 53 drill used to drill a hole in the center to accommodate the plate pins of the 832A. Through the side of the ⅜ inch piece a 6-32 tapped hole is made in the approximate center for securing it tightly to the plate pins. On top of this ⅜ inch piece, another ½ inch diameter disc ⅛ inch thick is secured to the ⅜ inch piece by 2-56 screws located 120 degrees apart. Between these two discs the ½ inch wide ribbon leading from the tuning capacitor is placed and tightened. In this fashion uniformity is carried right through.

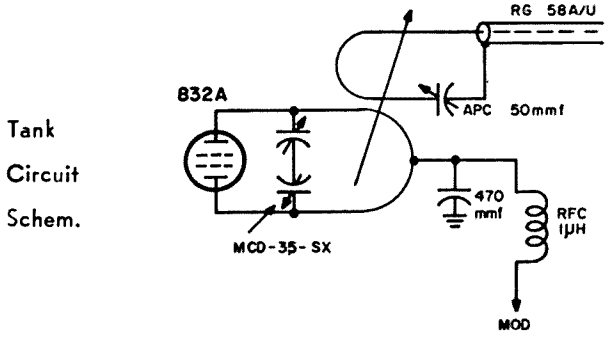
The assembled unit can be mounted by several methods to suit individual arrangement.

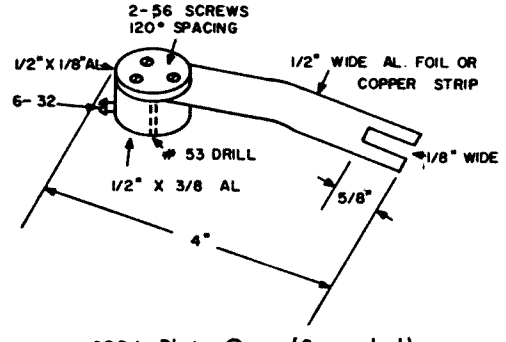
Antenna Coupler

One of the most awkward pieces on VHF transmitters is the pick-up loop. There are numerous ways of arranging components, but they all seem to be awkward in doing the job. Several attempts were tried to simplify this gadget and the one herewith shown seemed to be ideal. It was built as a separate package with all components nicely grouped, as shown on the photo.

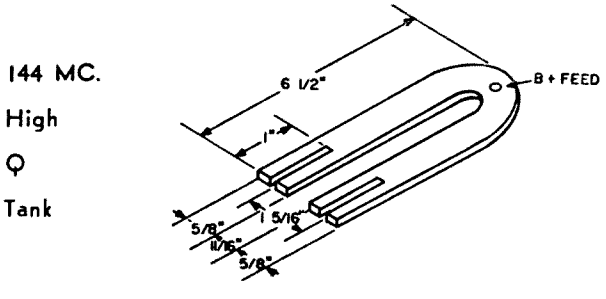
Construction

The main part of the pick-up loop is the





832A Plate Cap. (2 needed)



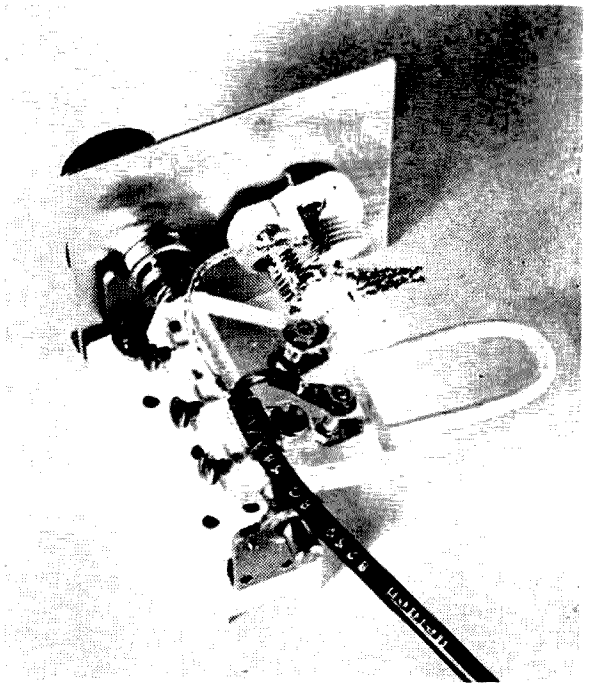


Photo showing the antenna coupler as a complete module. The coax braid can be seen soldered to the rotor tab of the APC capacitor. The center conductor of the coax is fastened to one side of the hair pin.

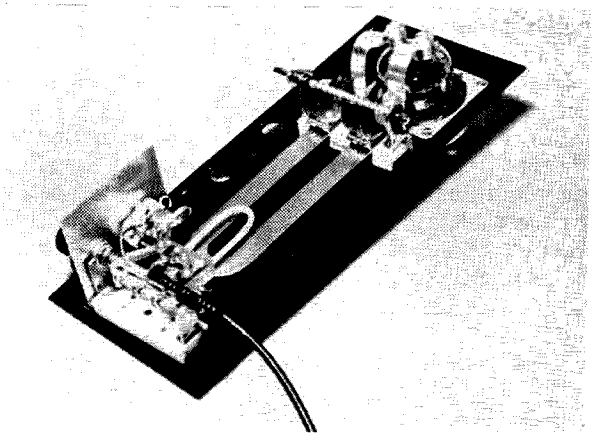


Photo showing compted high efficiency, High Q VHF Power Amplifier.

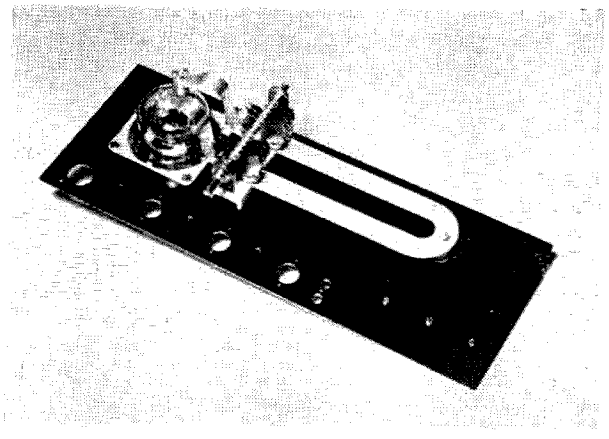
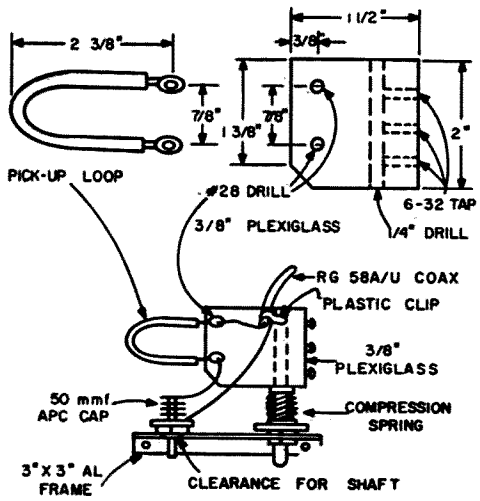


Photo showing the horse shoe tank circuit, modified capacitor and the assembled 832-A tube caps. The chassis painted black is for picture use only.



Antenna Coupler

capacitor frame, in this case borrowed from a Hammarlund MCD-35-SX capacitor, but a compatible unit can be used. The stator plates are removed, the rotor plates are stripped and shaft rounded by removing all solder. A piece of ⅜ inch plexiglass 2x1½ inches is cut as shown, and holes drilled for securing the pick-up loop and the RG58A/U coax cable. A ¼ inch hole is drilled lengthwise through the 2 inch section for the shaft. This hole is drilled ⅜ inches from one end and three 6-32 tapped holes are provided for tightening the plexiglass to the shaft.

Before assembling these parts, put a strong spring against the front bearing, then slide the plexiglass on the shaft, press against the spring and tighten the side 6-32 screws. This adds extra friction and allows the pick-up loop to be positioned solidly.

A piece of 1/16 inch aluminum measuring 3 x 3 inches with a ½ inch flange on the bottom is drilled to accommodate the hairloop frame bearing, and on the same line 1⅜ inches to the left, drill three holes to accommodate a Hammarlund APC type 50 mmfd capacitor with a ¼ inch shaft. These capacitors can be purchased at surplus stores. If in doubt about capacity buy one with many plates and cut it down to have a total of 13 or 14 plates. Mount this capacitor on the 3 x 3 inch plate but make sure that the shaft does not come in contact with the mounting plate. The reason behind this is that one point ground should be used to carry the rf and that ground is the shield of the coax cable, as shown on the schematic. This capacitor is used as fine loading adjustment and should be tuned in conjunction with the pick-up loop, to tune out the reactive component of the antenna system. In extending the shaft for panel control, use a insulated coupler.

The RG58A/U coax cable is tightly secured to the plexiglass by a plastic clip, as shown, and the inner conductor is fed through a brass screw to one side of the loop. The other side of the loop is fastened to the screw on the bottom of the plexiglass which projects through and fastens to the ¼ inch copper braid that is soldered to the stator of the APC capacitor. The rotor contact of this capacitor is soldered directly to the RG58A/U coax braid.

Pick up loop is made of No. 10 or 12 copper wire, with spaghetti insulated, and the ends have solder lugs so that it may be formed on the bench before fastening it in place.

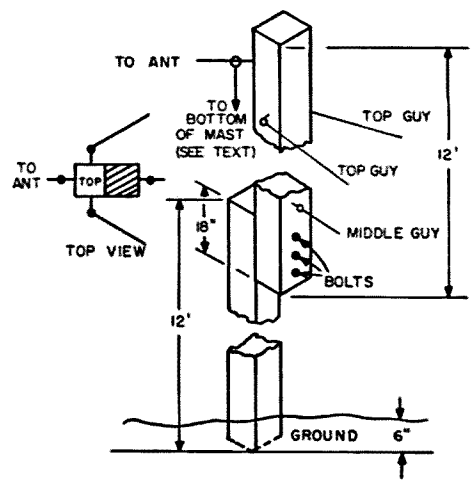
This high efficiency High Q tank circuit is used in the "Echo De Luxe" 144 mc transmitter to be described in the coming issue of 73 ..... Watch for the article ... W9DUT

Simple Antenna Mast

Jim Cannaliato K3LTB/5

RECENTLY I moved from Baltimore, Maryland to Roswell, New Mexico and, of course, my ham gear went right along with me. As my stay in Roswell is of a temporary nature I was immediately faced with the problem of setting up my station in such a way as to facilitate its rapid disassembly on short notice. The transmitter, receiver and associated equipment presented no difficulties in this department. My problem was the skyhook.

The antenna set up had to have certain qualities. Besides being reasonably effective it had to be simple, inexpensive and very easy to put up or take down. Since my favorite bands are 40 and 15, the standard dipole was decided upon and the junk-box produced the necessary #14 wire, insulators, etc. The next problem was a mast to attach to one end of the dipole, the other end being tied to the roof of the house. The solution to the problem was ex-



tremely simple and cost less than $4.00, not counting the guy ropes which were already on

hand.

Two sections of 2 x 2-inch poles, each 12-feet long, three 4½-inch bolts with nuts and four eye-hooks were purchased. Overlapping the two poles 18-inches, three holes were drilled and the bolts inserted and tightened down. Three eye-hooks were attached at the top and the fourth at the junction in the middle.

A 6-inch hole was dug and the guy ropes attached. On the end of the antenna a long rope was tied. This rope was pulled through the middle eye-hook at the top and is long enough so that it will rest on the ground after the mast is raised. This makes it possible to lower the antenna after the mast is up.

I then grabbed the XYL and coaxed her into lending a hand steadying the mast while it was raised and the guys tied down. The antenna was pulled up completing the entire operation in less than five minutes.

The ease of disassembly and simplicity of the mast was proven when we moved across town recently. Surprisingly enough the entire assembly turned out to be very sturdy and has held up much better than anticipated. I am now toying around with the idea of adding a ten meter ground plane to the system by simply running some #14 up the side of the mast, using the radials as extra guys.

Naturally this mast is not the answer to the needs of the permanent QTH. It probably won't last more than a couple of years and from an electrical standpoint it obviously is not the ideal half-wavelength above ground. However it is quite adequate for those of you who find yourselves moving around quite a bit (servicemen, etc.) or for Field Day and may prove helpful for erecting that cheap, temporary antenna system without putting any dent in the pocketbook. . . . K3LTB/5

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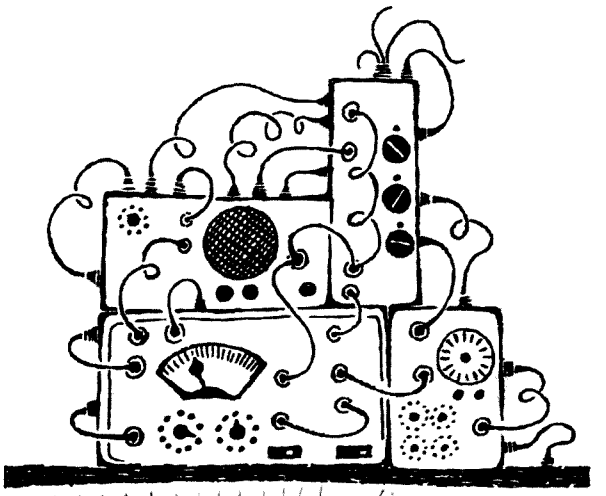
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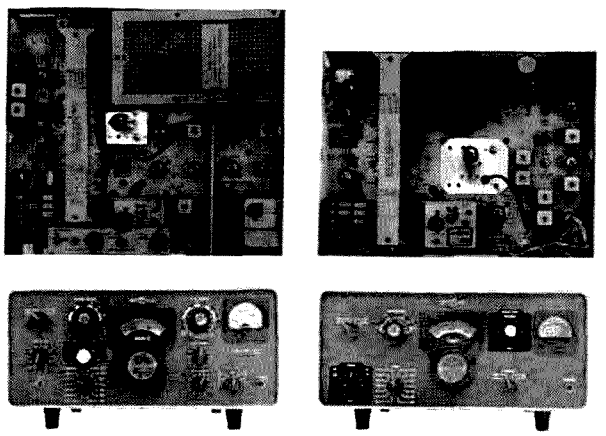
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WATERS



UNNETTLES RIGS

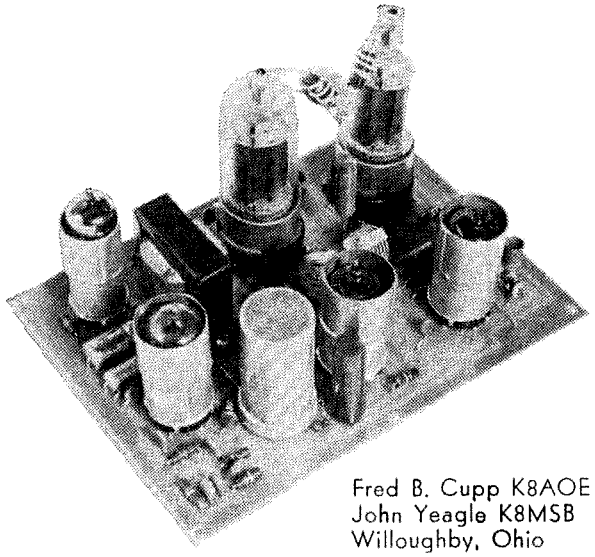
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AM–DSB Transmitter

6 Meters

Vox

Printed Circuit

Fred B. Cupp K8AOE
John Yeagle K8MSB
Willoughby, Ohio

ON the VHF scene, many manufacturers are bringing forth interesting new transceiver designs, but these are all AM systems. The home brew builder seems to have been left behind. Here is a project of special interest only to the home brew fan . . . a Six Meter AM-DSB transmitter with VOX included and all on a 5" x 7" printed circuit board.

Very few people will argue the validity of the claims made for the superiority of sideband operation. The increasing popularity of this mode of transmission on the lower frequencies attests to this. In the VHF range, however, sideband has yet to leave a very sizeable mark. The reasons are obvious. Only a small percentage of hams are ambitious enough to attack a project of this magnitude for VHF. Many manufacturers have good exciters for the lower bands, but none have been bold enough to bring forth an exciter specifically for VHF. The recent appearance of commercial transmitting converters is a step in the right direction but they are of no value to the ham who has no exciter.

Consider the Six Meter band. A majority of the operators are Technician Class licensees and have no reason to acquire a low band exciter. Here then is fertile ground for development of techniques and equipment. Simple transceivers have their place in the VHF sun, but the serious ham who is interested in the more exotic forms of communication is soon disillusioned with the limitations of commercial equipment.

After several years of apprenticeship on AM, we indulged in a brief courtship with FM. Somewhat better to be sure, but still not the ultimate. The purchase of several sideband books strengthened our resolve, but the cost of filters and the complexity of phasing rigs and **he**trodyne converters led to the final acceptance of Double Sideband Suppressed Carrier as a reasonable compromise.

Reception of Double Sideband signals is accomplished in exactly the same manner as single sideband signals, but ..... The presence of both sets of sidebands imposes stiffer requirements on the receiving equipment. In exchange for transmitter simplicity we are requiring the receiving station to filter out the unwanted sideband. Stations have been worked by the author wherein the DSB signal was received on a Collins 75A-4. The reports were that either sideband was received just as well as an SSB signal. Other contacts made on less sophisticated receivers indicate that a steady hand is necessary. Two contacts were even made with stations using G-50 communicators in which case the VFO was turned on and used for carrier reinsertion.

The important case to be considered, however, is the average station. In all probability the if response is broad enough that both sidebands will be received. In this case, the two sidebands beat against each other as well as the BFO, producing a peculiar "growling" type of distortion. The only cure is to have the BFO frequency right "on the nose," although the effect is reduced by detuning the receiver so that the unwanted sideband is down the slope of the if response curve. This effect is not too bad to overcome especially if the receiver has a "Q" multiplier in which case the reception is just as good as SSB. The subject of double sideband reception is discussed at some length in Don Stoner's "New Sideband Handbook," page 107.

Several prototypes (and six months) later, members of the East Shore VHF Club of Cleveland, Ohio showed interest in the project. This was the spur necessary to push us into laying out a printed circuit board so that the club members could duplicate the design with a minimum of difficulty. This final design included several extra refinements such as a tone oscillator to facilitate tune up on DSB and **an** improved VOX circuit which is used on both AM and DSB. Also provision has been made for either 6 or 12 volt heater connections.

Audio Section

The first half of a 12AX7 is a speech preamp. When the microphone is unplugged, however, the closed circuit phone jack completes the circuit from the R-C phase shift network causing the preamp to oscillate at approximately 1 kc. This tone is used for tune-up on both AM and DSB. With the mike plugged in, the 12AX7 functions as a normal speech preamp. The output of the first stage is coupled through the .001 capacitor to the audio gain pot. This capacitor value is deliberately small to roll off the low frequency response to provide better intelligibility, primarily on DSB. The second half of the 12AX7 is a standard voltage amplifier.

VOX Circuitry

The output of the speech amplifiers is fed to the 6AQ5 modulator via switch section S1A and also to the VOX trip level pot. The first half of the 12AU7 is a voltage amplifier and its output is coupled through the .02 capacitor to the voltage doubler rectifiers. An audio signal thus results in a negative voltage being developed at the grid of the relay tube, the second half of the 12AU7. The 6.8 meg. grid resistor gives a positive return of the grid voltage and eliminates any tendency of the relay to chatter on noise spikes. Note that the VOX relay K1 is energized during receive and de-energized for transmit. This provides a more uniform load on the power supply since the rf section draws current when the VOX tube is cut-off and vice-versa.

Modulator

Referring now to the 6AQ5 modulator stage, it will be noted that switch section S1A selects either the full audio signal or audio via a 6 db attenuator. This is done to avoid the necessity of changing the audio gain and VOX trip settings when switching from DSB to AM, since AM requires only half as much modulation as DSB. In the DSB mode of operation switch section S1B grounds the center-tap of the modulation transformer. Thus the modulation energy supplies the screen voltage for the 2E26 balanced modulators. In the AM position, switch section S1B connects the center-tap to a voltage divider across the B+ supply thus applying constant screen voltage. The modulation voltage appearing across half of the secondary then adds to or subtracts from this screen voltage resulting in AM screen modulation. Note that in AM operation switch section S1C disables one of the 2E26 tubes. Since the balanced modulator is no longer balanced the carrier is not cancelled out and normal AM operation is achieved.

RF Section

The pentode section of the 6U8 is used as an oscillator-tripler combination. The screen is used as the plate in an untuned Pierce oscil-

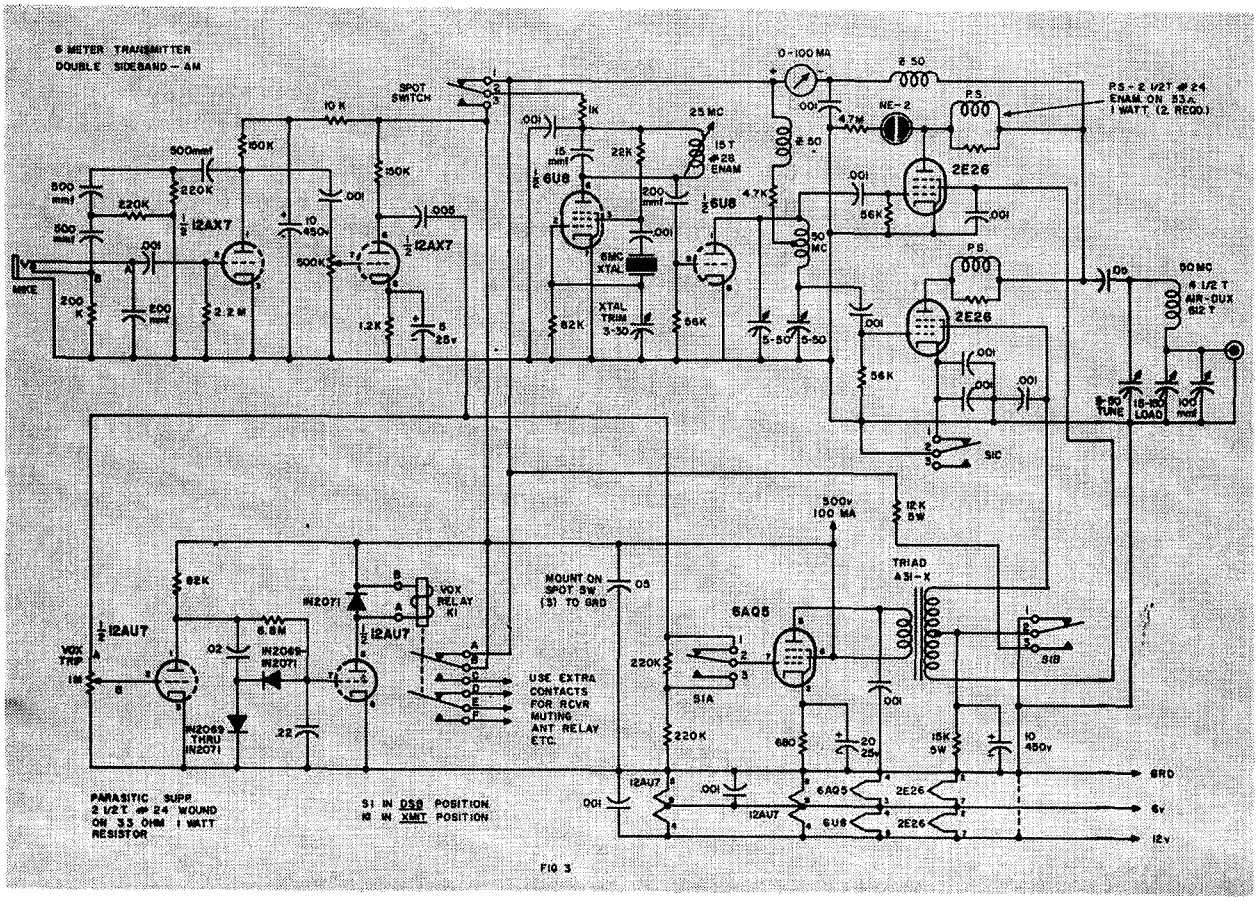


FIG 3



Here's the VHF Receiver you've dreamed of—CLEGG'S new INTERCEPTOR for 6 & 2!

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- ★ **Virtually no cross modulation.**
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- ★ **Stability equal to exacting requirements of SSB and CW.**
- ★ **Hermetically sealed 10.7 Mc crystal lattice filter that provides optimum selectivity for both AM and SSB. Selectivity 3.1 kc at 6 db points; 8 kc at 75 db points.**
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- ★ **Input provision for 220 Mc, 432 and other UHF converters.**
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- ★ **Cabinet and panel matching the Zeus transmitter.**

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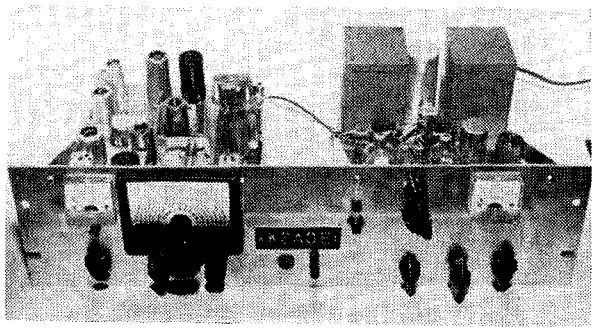
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lator circuit. A 3-30 mmfd trimmer capacitor allows the crystal to be "rubbered" in the event of net operation or it may be adjusted for maximum drive. The plate of the pentode section triples to 25 mc. The tripler output is applied to the triode section of the 6U8 which doubles to 50 mc. The triode plate is connected to one end of the push-pull grid tank thus supplying a 180 degree phase shift between the grid voltages of the 2E26 balanced modulators. The push-pull grid circuit was chosen to allow the use of pi-network output rather than push-pull output with a link output coupling. Balance in the push-pull drive is accomplished by varying the ratio of the two trimmer capacitors at the opposite ends of the grid tank. Of course the capacitors must always be tuned for resonance as well as balance, but a little practice will allow re-tuning in a short time once you get the hang of it. (Several rigs have been built with a dual 25 mmfd air variable across the grid tank, however the one trimmer capacitor must be left on the end of the tank opposite the triode plate to balance out the plate capacity. If the builder desires, this modification may be added by mounting the dual variable on the front panel in such a position that the variable extends under the board near the grid tank. Short leads should be used from the variable to the tank circuit.)

A VTVM with a 100K resistor in series with the probe (to avoid detuning of the tank circuit) is used to check the grid voltages of the 2E26's while adjusting the balance. This setting is not critical, however, and relatively good carrier null can be obtained even without this check. The parasitic suppressors in the plate circuit of the 2E26's are for obvious purposes. The NE-2 neon bulb serves as an rf indicator (very impressive on DSB) and the 4.7 meg. resistor applies "keep alive" voltage to the neon bulb. The pi-net output circuit is quite standard. The 100 mmfd capacitor across the loading capacitor is to shunt the load control to the desired range, thus permitting the use of a physically smaller variable capacitor. This allows it to be placed as shown between the 2E26 tubes.

While the transmitter can be built on a regular chassis, we found that a circuit board greatly simplified matters. Fabrication of printed circuits has been covered in past issues of this and other amateur publications. If the builder does not wish to make the circuit board himself, the board is available from the authors at $7.50. This circuit board is Mil. grade glass epoxy with heavy copper coating and is tin plated for easier soldering. Also included are double-sized parts layout drill guide instruction sheets, a complete parts list, and everything else we could think of to help you.



Use sharp drills for all holes and do not overheat the copper while soldering. Reasonable parts substitutions can be made, of course, but check for physical size to insure that the new part will fit on the board. After drilling the holes, insert the parts in the board and solder. The four components located on the underside of the board are the grid tank coil, two .001 coupling capacitors to the 2E26 grids, and the 6.8 meg. resistor in the VOX circuit.

Now set the completed board aside and drill the holes in the 5" x 7" chassis. The DSB-AM switch, the audio gain pot and the dual variable (if desired) are mounted on the front of the chassis. The VOX trip pot and the VOX relay are mounted on the rear of the chassis. The actual location of the relay and the output connector will depend on the physical size of these components. Next an opening is cut in the top of the chassis to fit the printed circuit board. An ideal tool for the job is a nibbler (Adel Mfg. Co.). The front panel is held to the chassis by the controls mounted on the front of the chassis.

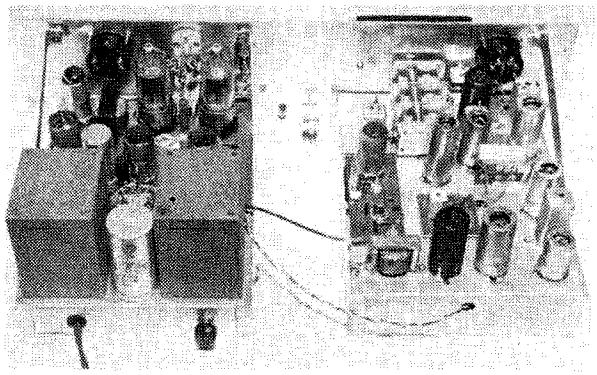
After all the parts are mounted the wiring may be completed. Dress the wiring in such a manner as to avoid the location of the shield partition which is left until last to permit easier wiring. The two 5 watt resistors may be mounted on terminal strips on the side of the chassis or between switch section S1B, terminal 2 and the shield partition for the 15K resistor and switch section S1B, terminal 3 and B+ on the 6AQ5 screen (pin 6) for the 12K resistor.

When the wiring has been completed, cut a piece of thin brass for the shield partition and solder it in place. Don't forget to cut a notch in the shield to clear the two conductors on the circuit board which pass under the partition.

Transmitter Checkout

After checking with an ohmeter for possible shorts on the filament or B+ lines, apply power. Install the 12AX7 speech amplifier tube and check with a scope (or VTVM) for output to the modulator grid. Check both with a mike and also for the tone oscillator with the mike unplugged. Tubes other than a 12AX7 or a weak 12AX7 may not have enough gain to oscillate. Also don't forget to install the jumper between the 12 volt heater connection and ground when operating on 6 volts.

Next the VOX tube (12AU7) may be installed. After warmup the relay should energize. Turn the VOX trip level pot until it is about 75% open. If the mike is unplugged (tone oscillator on) then increasing the audio gain control setting should cause the relay to



de-energize. Speaking into the mike should also cause the relay to drop out.

The 6U8 exciter is next checked out. Leave the audio gain control turned up so that the VOX relay remains de-energized and tune the tripler plate tank for maximum output. Insert the two 2E26 tubes in their sockets. Tune the grid tank of the 2E26 tubes to resonance. (Note that the DSB-AM switch must be in the DSB position.) With a 100K resistor in series with the probe of a VTVM read the voltage on each of the 2E26 grids. Increase the capacity of the trimmer on the grid with the highest voltage, then retune the grid tank to resonance with the other trimmer. Repeat this procedure until both grids read approximately the same voltage and the tank is at resonance. If you have added the dual 25 mmfd variable across the grid tank the job is a little easier. Just tune the remaining trimmer capacitor for balance and the dual air variable for maximum voltage on the grids.

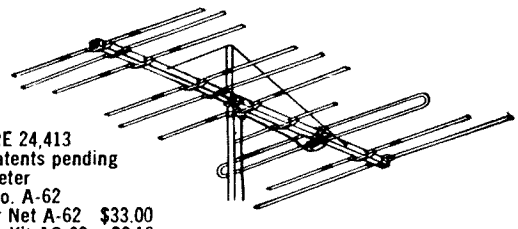
The last step is to add the 6AQ5 modulator. With tone modulation advance the audio gain control until the plate current is about 50 ma. A scope pattern is almost essential here. Feed audio from one of the screens to the horizontal input of the scope and rf from across a dummy load into the vertical plates. The pattern should look like the typical "Bow Tie" display of double sideband transmission (ARRL '61 Handbook, p317, Fig. 11-15).

With the DSB-AM switch in the AM position the plate current should be 35 to 40 ma. The scope pattern should now be the typical trapezoid characteristic of AM. These current values are for a B+ voltage of approximately 300 volts. Some intrepid souls may wish to increase the output by running the final amplifier plates from a higher voltage supply, although we have not tried this. If you care to try it, disconnect the + side of the plate supply meter and connect it to a higher voltage supply.

As far as performance is concerned, the authors are not DX hounds, so the DX record is rather sparse, consisting of one Florida contact on a band opening, one extended ground wave contact, but many hours of local ragchews. Morrie, WA6CTL, is now the owner of the prototype and he sends back glowing reports of the rig's performance on ground wave between San Diego and Los Angeles. The authors hope to hear many of you on DSB in the future. ... K8AOE & K8MSB

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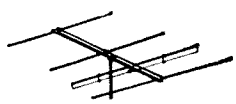
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Twoer Modifications

Ernest Jay Wolitzer K2ORY
2143—82nd Street
Brooklyn 14, N. Y.

Photo credit: Elliot Eckhaus, K2GUI.

THE Heath transceiver units, commonly known as the Tener, Sixer & Twoer are excellent units in regard to operation, size, and cost. This article is based on the Twoer, but will hold the same for the others.

The Twoer was used in the home QTH for a while, and I became interested in using the rig mobile. As some of us might know, setting up a mobile rig takes time and most of all, patience.

In the Twoer, described here, I did away with all of the hard work, such as running cables, mounting power supplys, etc. The unit now will operate either 110 vac or 12 vdc at the flip of a switch.

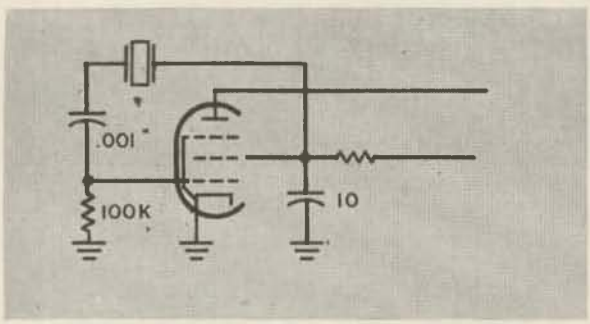
If ever it came to mind to use a VFO, you would probably not be too successful, because with the original oscillator circuit a VFO could not work. I made some minor oscillator changes that helped to stabilize the unit when a crystal was used, and now I can use a VFO.

Construction Details

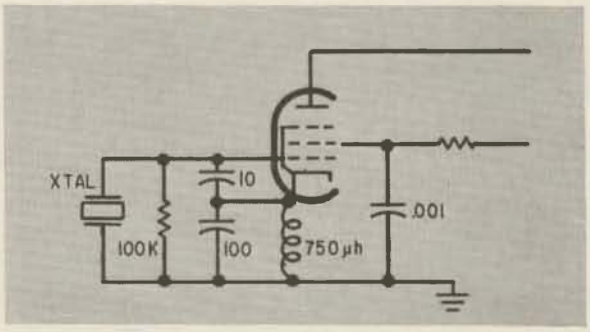
The fuse holder in the rear of the unit was removed and mounted in the space that had originally been used for the eight pin power plug. The hole that was used for the fuse is now the mounting hole for the new switch.

Part of the power supply is built on a sub-chassis which is mounted on the speaker baffle plate. This sub-chassis, measuring 3½ in. L. by 2¼ in. W., is made of a piece of ⅛ in. steel. A ½ in. lip is bent and used for mounting.

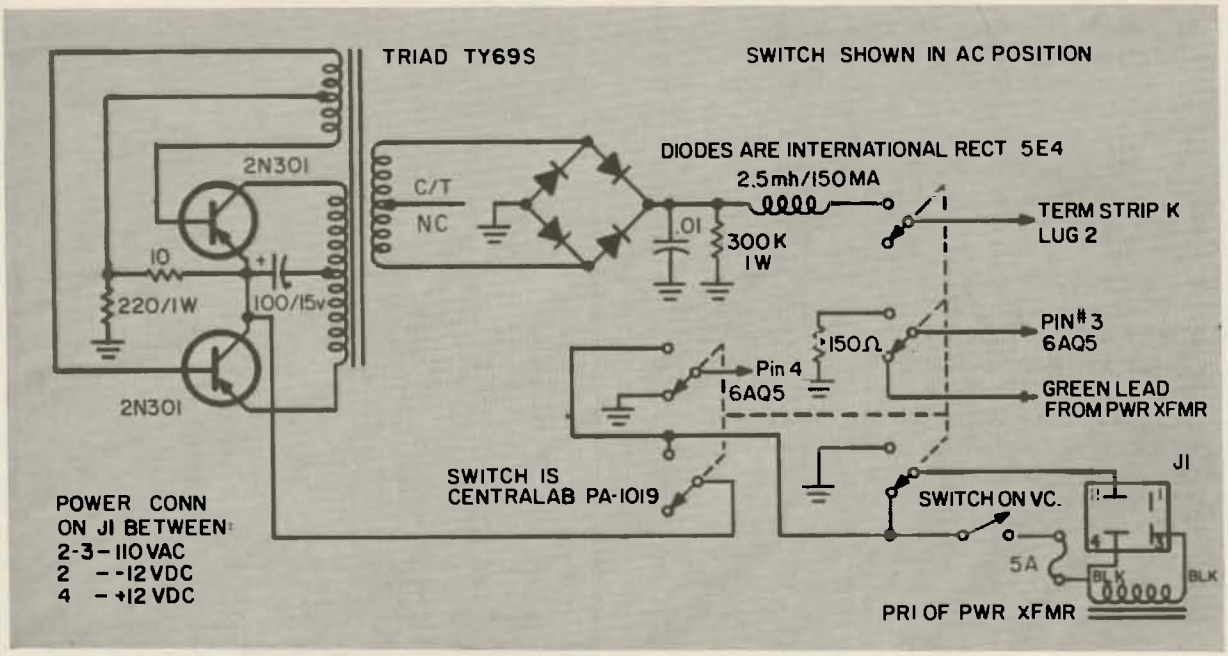
The silicon diodes and the rest of the power supply components are wired on a terminal strip, which is then mounted on the screw that holds the power transformer. The four prong power plug is mounted on brackets, and is positioned near the output transformer. It will be found that in order to have access to the

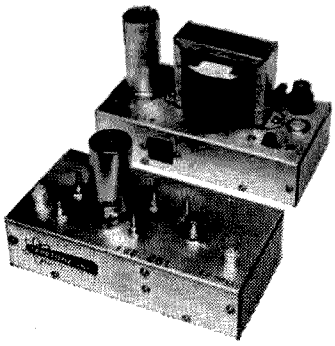


Before



After





73 tests the Telco 201 Converter

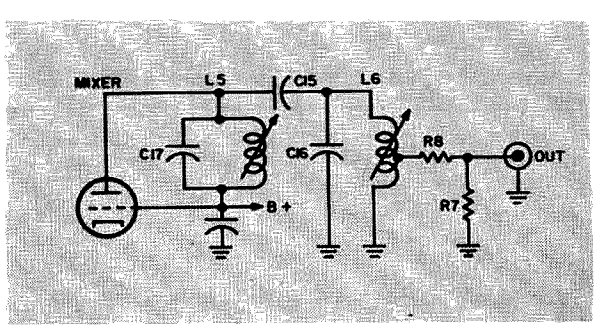
Larry Levy WA2INM
1114 East 18 Street
Brooklyn 30, New York

IN most heavily populated areas, 6 meter operation is getting to be a problem. There are so many stations on six that one or two strong stations are sure to be close enough to overload your six meter converter. With conventional 6 meter converters, the overload can be controlled, but only at the expense of noise figure. Such a compromise is usually a poor one, as it doesn't do much good to eliminate the overload if, after you do, you can't hear the station that you're trying to work. If you have a problem of this kind, the answer is a Telco 201 converter. The 201 is a low noise 6 meter nuvistor converter that is almost impossible to overload. Built and designed with the same quality that Tapetone is famous for, the 201 is undoubtedly the best 6 meter converter that I have ever heard. Tapetone rates the noise figure as better than 3 db. On the converter tested, the noise figure is considerably better than 3 db, probably between 2 and 2½ db. The reason that I say probably is that I can't measure a noise figure better than 2½ db with my present test equipment.

Anyhow, Tapetone is extremely conservative in their ratings, giving, a very consevative and true figure instead of an advertising fudge figure (true noise figure x .69 or something). This is achieved by the use of a 6CW4 nuvistor in a gounded grid rf amplifier. The rf stage is designed to provide maximum protection against overload without sacrificing noise figure. The cathode is carefully matched to the line, which should be a reasonably flat 50 ohm unbalanced one, by a tapped coil which is tuned for optimum performance. The plate circuit is one of Tapetone's double-tuned types which offers almost flat response across the entire 6 meter band, dropping off sharply at either end. The mixer uses ½ of a 6U8 in a circuit designed to reduce overload.

Tapetone did quite a bit of experimenting before they decided to use the 6U8. They were trying to find the best tube for noise figure as well as resistance to overload, a combination that requires several contradictory qualities. The 6U8, with the circuit values chosen, is a perfect choice. The noise figure is exceedingly low and it is as resistant to overload as a mixer is going to get. One unusual feature, and one that is getting extremely important as the band is getting more and more crowded, is the mixer output circuit. They use two coils, in a bandpass configuration, to provide almost perfect response across four megacycles. It is then matched, by a tap on the second coil and two resistors, to a flat 50 ohm output. (See Fig. 1). This is the only converter that I have seen using this, and it is important because it is just about impossible to get a flat response out of the conventional single coil that everybody seems to be using. This means that the converter using one of these coils has a flat response over 1 mc of the band at most, and the majority of them do not even have that much. With the increasing activity on the band it is not uncommon now to hear stations as high as 52 mc or more, and the ancient converters that were designed when you didn't have to tune over 50.1 mc to cover all the activity are now well outdated. It should be pointed out that while, with luck, a coil will tune 1 or 1½ mc reasonably flat at 50 mc, it will only tune less than ½ mc at 14 mc, since the bandwidth decreases with frequency. Since the rf bandpass is 4 mc and the output response is also 4 mc, this converter not only has a flat response over the entire band, but it also has a fantastic image rejection and suppression of feedthrough. This is because the more tuned circuits that there are, the greater the skirt selectivity. In the 201 there are two sets of bandpass circuits and the rejection of signals outside the passband is greatly increased.

The signal from the oscillator is fed into the cathode of the mixer. The Telco 201 only comes with an *if* of 14-18 mc, probably because Tapetone felt that image rejection would suffer if a lower *if* was used and most receiver's performance drops off if a higher one is



used.

I mentioned that the converter is hard to overload. How hard? For a test, I loaded my 100 watt transmitter into my 11 element beam and pointed it at a receiving dipole about 50 feet away. There was no interference with a received signal that was S-3 15 kc away from my transmitter except on strong modulation peaks. Even this disappeared about 20 kc away from my signal, and the overloading was probably due to my receiver.

While this test is a little rough for any converter and, I'm sure that Tapetone never designed it to resist overload like that, it performs perfectly under these conditions. Part of this quality, I think, comes from the fact that the rf amplifier has no more gain than is needed. The converter has more than enough gain for even the simplest receiver and yet not enough to cause overload. This seems to be against the current trend to provide so much gain that the receiver doesn't need an "S" meter. It is only necessary to connect an O-1 ma "S" meter to measure the grid current of the mixer tube to tell the strength of the received signal. When an "S" meter is used, it reads 60/9 whenever a car starts up within a mile.

I would like to point out that the cause of cross modulation and related side effects is the fact that when a signal is strong enough to overcome the bias on positive signal peaks, the mixer will draw grid current and act as a detector. The audio voltage that is detected will modulate the received signals in the same way that a transmitter is grid modulated. This causes the effect of hearing one station's audio on all signals received. The 201 has the proper amount of gain and, therefore, these effects are missing. Even if there's no other stations within 100 miles of your mountain-top QTH, the 201 is still an ideal converter. Since, with a given bandwidth, the limitation of band (cosmic) noise still exists, the 201 will receive the signal perfectly, if it is at all possible to receive it. The noise figure of the 201 is well below natural noise in even the quietest location.

Even with all this, the Telco 201, at $37.40, is priced below the cost of a parametric amplifier. It is also more compact, being built on a 1½x3x6 inch chassis. The black and silver chassis is an attractive addition to any ham station. The connectors are the "BNC" type, which have a much lower loss than the "UHF" or Motorola types, besides being smaller and more convenient to work with. In conclusion, the Telco 201 is an amazingly low noise converter for 6 meters that is a real bargain at $37.40.

Gripes

Being of the type that has to find something to complain about, I have one complaint about this convertor: Why didn't Tapetone make this sooner? . . . WA2INM



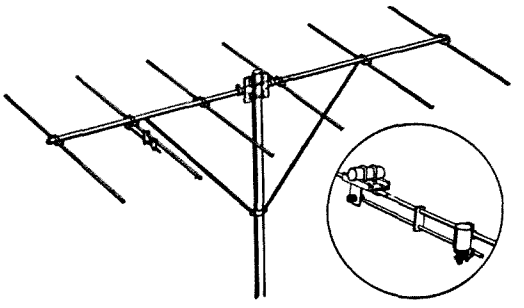
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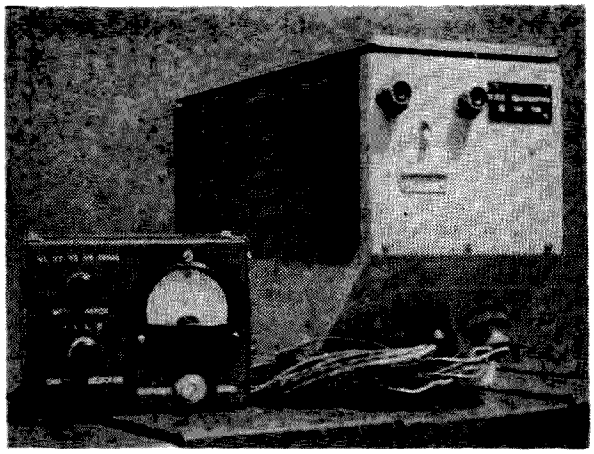
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To keep internal wiring changes to a minimum I decided to build a low voltage dc supply to run the motor and the relays. The filaments were disconnected from the 28 volt line and rewired for 12 vac. There are two good reasons for this change: (1) the filaments draw a lot of current and that would mean a high current rectifier system which would be expensive. (2) The relays and bandswitching motor will run on anything from 20 to 40 volts, while the filaments must stay within 10% of 12 volts. This makes it easy to find a transformer for the low voltage supply.

The two sockets on the sloping front of the transmitter and the one on the rear should be replaced with octal sockets since the original connectors are hard to find. The octal sockets will fit in the original holes. I found a plug to fit the control socket so this one did not have to be replaced. When you put in the octal sockets the best way to keep track of what is on each pin is to connect the wires from the original to the corresponding numbered pins on the octal socket. At the power socket on the rear of the transmitter pins #1, 2 and 6 are shorted together. The wire on pin #3 should be disconnected and run to the front of the transmitter to the control unit socket. This wire will be taken care of later. Make sure #4 is grounded. #7 will be modulated high voltage. #5 will have the low voltage dc for the motor and relays. #3 is the filament pin.

The filaments should be rewired as follows: At the 1625 oscillator and the final 832A no changes are made. At the second 1625 move the filament wires (filaments are the two large diameter pins) all to one of the pins and ground the pin from which the wires were just removed. At the first 832A move filament wires from one filament pin to the other and ground the pin from which the wires were just removed. This puts the filaments in parallel. Now a wire should be connected from the ungrounded side of the filaments at the first 832A to pin #3 on the power socket at the rear of the transmitter. After this is done make sure that no original wiring is still connected from the filaments to the 28 volt line or trouble will brew.

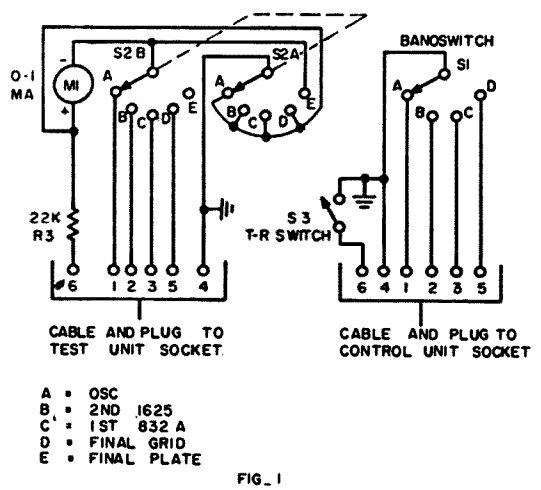


FIG. 1

*Surplus Radio Conversion Manual Volume #2 (Radio Bookshop).

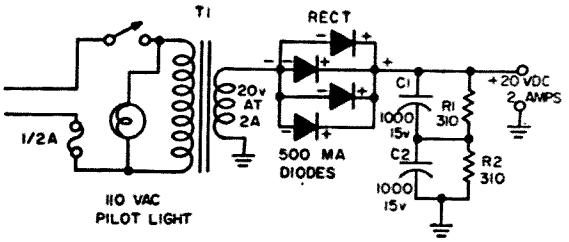


FIG. 2

Controlled Circuit Changes

Now let's take a peek at the control and metering circuits. At the control unit socket remove the wire that is on pin #6 and ground it at a convenient spot (pin #4 will do). Now take the wire that was disconnected from pin #3 on the rear of the chassis and connect it to pin #6 on the control unit socket. That's all at this socket and no changes are made at the test unit socket. This takes care of all the changes in the transmitter for operation on the original frequencies. The simple coil changes for 50 and 220 will follow the control unit and power supply discussion.

Control Unit

The control unit is simple and consists of a bandswitch, a transmit-receive switch and a meter. Bandswitching is accomplished by shorting the desired band control line to ground. This starts the turrets in motion and they will stop when the desired band is reached. The bandswitch (S1) is a single pole 4 position rotary. The TR switch (S3) is a SPST and it shorts pin #6 on the control socket to ground, closing all relays. Pins #1, 2, 3, and 5 are band control lines for bands A, B, C, and D respectively. Pin #4 is ground, and pins #7 and 8 are not used. The meter (M1) is a 0-1 ma. The meter switch (S2) is a 2 pole 5 position rotary. Position A goes to pin #1 on the test unit socket, B goes to pin #2, C to pin #3, D to pin #5, the positive side of the meter goes through a 22K 1 watt resistor to pin #6. The ground lead is pin #4. As on the control unit socket, the pins #7 and 8 are not used. Refer to Fig. 2 for the wiring of the control unit.

Power Supply

The voltages necessary to operate the transmitter are 12vac, 20-40 volts, 300-600 volts for plates and 300-600 volts modulated for the final. Low voltage for the screens is supplied by a voltage divider inside the transmitter. I found a 20 volt transformer for five bits so I used a half wave rectifier circuit. The rectifier consists of four 500 ma 100 volt silicon diodes in parallel. These are very inexpensive in the surplus stores. The filter uses two 1000 mfd 15 volt electrolytics in series with two 310 ohm 1 watt equalizing resistors. I use my regular station supply and modulator with about 400 volts on the plates. Connections are made to the rear power socket as follows: Pins #1, 2 and 6 get high voltage, pin #7 gets modulated high voltage, pin #3 gets 12vac, pin #4 is ground and pin #5 is for 20-40 volts dc at 2 amps.

Table I

Tube	6 M	2 M	1¼ M
Xtal at 1625	8 mc	8	8
output 1625	16 mc	16	24
2nd 1625	48 mc	48	72
1st 832A	48 mc	144	216
final 832A	48 mc	144	216

Coil Changes

Though I am using the transmitter in this fashion, any variety of the four bands could be used.

Band A—6 meters—coil change necessary
Band B—2 meters—no coil change
Band C—1¼ meters—coil change necessary
Band D—2 meters—Entire band—no coil change

The following is necessary to put Channel A on 6 meters. Remove 3 turns from 3A and 3B. These are on the rear turret and are easily removed by removing a brass clip. Add a 22 mmfd ceramic capacitor across coil 4. This is between the two 832A's. The final should be rewound with 29 turns of #22 enamel wire and the link coil should be replaced with a one turn link around the center of the coil.

Shunt the loading capacitor with a fixed 40 mmfd fixed capacitor.

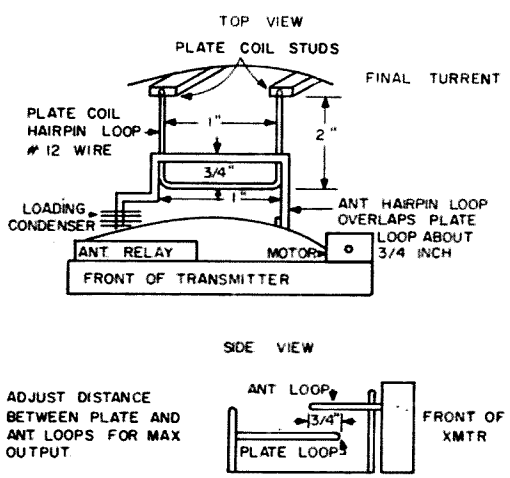
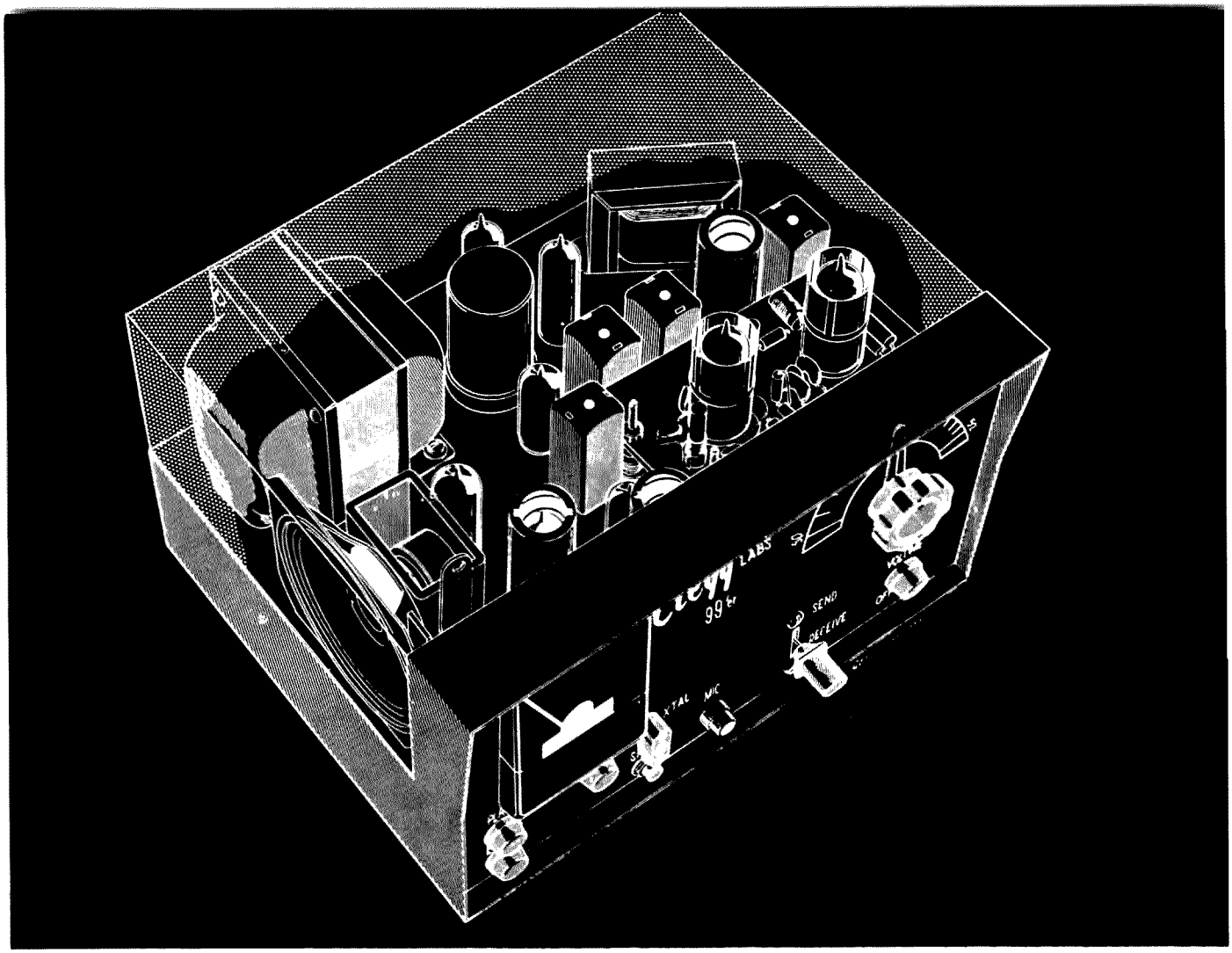


FIG 3

For 1¼ meters these changes are necessary. Band C was used. Remove all but 14 turns from the oscillator plate coil. Remove all but 5 turns from coil 3A. Remove all but 8 turns from 3B. Remove all but 2 turns from coil 4. Remove the final coil, antenna loop and the plate coil form. Mount a hairpin loop 2" long and 1" wide on the plate coil studs on the turret. The antenna loop should also be 1" wide and should overlap the plate loop by about ¾".

(Turn to page 29)



73 Tests the Clegg 99'er

Bill Pasternak WA2HVK
1525 West 8 Street
Brooklyn 4, New York

IF you do much in the way of six meter operating the report to be given here on the Clegg 99'er will be old stuff to you. By now you've heard several fellows using this new transceiver and you've heard them telling anyone who would listen just how much they liked it. You've heard the fine signal it puts out and the punch that you get from the adequate audio gain and good modulation system. After checking over the parts list for the 99'er I just don't see how it is possible for Ed Clegg W2LOY to sell this fabulous rig for only $139.95. He must do a lot of the wiring himself.

Until recently the ham on six meters had very little choice when purchasing a transceiver. He either had to spend about $300 for a communicator or suffer with one of the less expensive units. The main trouble with these inexpensive transceivers was in their receivers sensitivity and selectivity. However now that Clegg has introduced the 99'er, the problem has been solved.

The receiver is much better than is usually found in a transceiver and compares favorably with most communications receivers. It uses dual conversion with *ifs* at 10.7 mc and 455 kc. A 6DJ8/ECC88 twin triode (see 73, Nov. 1960 for more info on this tube) is used as a low noise cascode *rf* amplifier. The first conversion osc-mixer uses a 6U8/6EA8 (see 73, Aug. 1961, p. 18), with the triode section working as a tunable oscillator covering 39.3-41.3 mc. As you can probably gather from this, the receiver tunes only the first two mc of the band, affording excellent electrical bandspread.

The second mixer is a 6AN8. This is followed by a 6BA6 *if* amplifier and a 6AL5 detector, *avc* and *anl*. A line-up such as this provides plenty of gain while still retaining an excellent noise figure. The selectivity is very good because of the 455 kc *if*. Usually a transceiver has either selectivity or image rejection, mainly because of the choice of *if* frequency is a compromise between the two. The use of double conversion has the best features

of both a high and a low *if* frequency.

Incidentally, the 99'er is one of the only transceivers that I have seen that has a local oscillator stable enough to permit the use of high selectivity. There is virtually no noticeable drift after a four or five minute warmup. With a BFO this receiver would do fine for SSB reception. A large accurate, easy to read "s" meter is mounted on the front panel and doubles as a tuning meter for the transmitter. The transmitter is a somewhat conventional 8 watt crystal-controlled one using a 7558 in the final. The pi network permits the final to load a wide variety of load impedances. The final is very efficient and sounds like a lot more than 8 watts input, according to signal reports received. (Clegg's specs say that the unit puts out 4 to 5 watts.) The driver is a 6EA8 and will operate from either 8, 12 or 25 mc crystals. In addition, the unit will operate with a vfo and has input and control circuits thru the rear panel power plug for this operation.

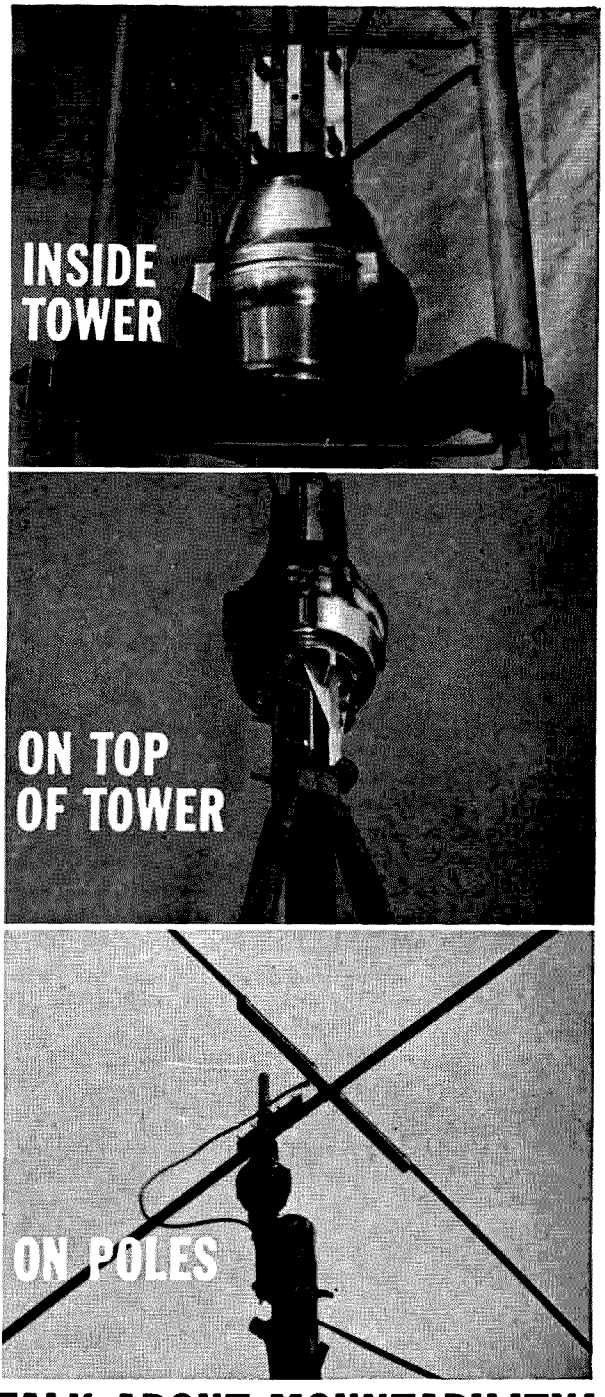
A very important feature is the spot switch, mounted on the front panel, which warns you before you louse up your frequency. The final amplifier is plate modulated by a 6AQ5 which doubles as the audio output in the receiver. The quality of the modulation is excellent and there is plenty of it. The 99'er has a gain control for the mic preamp which is a feature usually left out. While on the subject of features, the 99'er is loaded with them. The meter is automatically switched from "transmit" to a receiver "s" meter when the transmit switch is thrown.

The noise limiter works very well and it is in operation at all times. Clegg probably feels (as do I) that the limiter is used most of the time anyway, so why confuse the issue with an ANL switch. The power supply is not like most others. It uses a full wave rectifier (6BW4) instead of a half wave voltage doubler. I could never understand the use of voltage multiplier circuits in transceivers because for safety they have to use a power transformer anyway. If you are going to use a power transformer it is possible to get any necessary voltage without multipliers.

The full wave supply is much more efficient and easier to filter. The regulation of a full wave supply is far superior to any form of voltage doubler, which probably is the reason for the excellent stability of the receiver. The rig will work fine in the car if used with a 100 watt inverter. This can be reduced considerably if the tube heaters are connected directly to the battery.

I have been using the 99'er for some time now and I feel that there is little left out of the unit. It is quite attractive and a worthwhile addition to any hamshack. With the 99'er you get more than your money's worth. Congratulations to W2LOY and the rest of the crew in Mt. Tabor on a job well done.

. . . WA2HVK

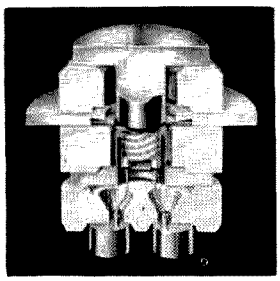


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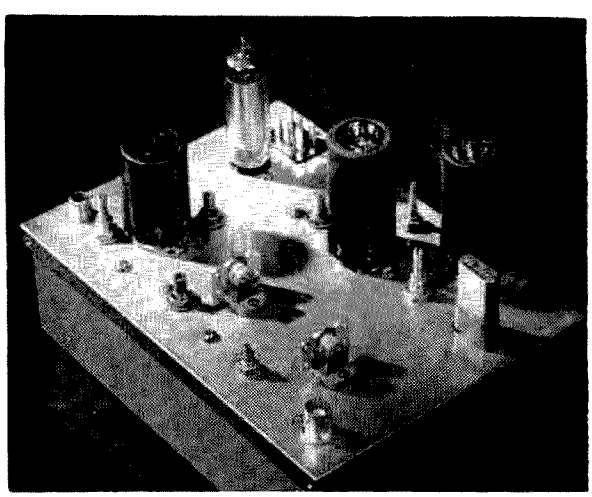


A 7077 Two Meter Converter



Dr. John B. Dillon WA6EWV
1071 Somera Road
Los Angeles 24, California

THERE have been many two meter converter circuits published using either the 416B or 417A tubes. To the best of my knowledge there has been only one description of the application of the GE-7077 micro-miniature triode! A commercial converter is now available, manufactured by Centimeg. This tube is extensively used in satellite and space circuiting because of its extreme ruggedness, small size, and excellent electrical characteristics.



Top view of converter. The rf and mixer stage are to the left, the oscillator chain to the right. The OA2 regulator for the oscillator chain to the rear. The plastic buttons visible hold the tectronix tie strips.

The 7077 is a high-mu triode of ceramic and metal planar construction pimarily intended for use as an rf amplifier in the 30-1200 megacycle frequency range. It features an extremely low noise figure throughout its frequency range. A noise figure of between 2.5 and 2.8 decibels is claimed for this tube in two meter application. The 7077 was the class B final in the transmitter of the Pioneer IV satellite whose signals were heard on 960.05 megacycles 407,000 miles. The objections to the tube are its present unavailability except new, its relatively high cost, special socket requirements and desirability of a regulated heater supply.

Anticipating the more ready availability of the tube, the converter herein described was developed, using what appear to be desirable features from several circuits. Several of the ideas of DL3FM[2], in particular are employed.

Construction

The converter was constructed on a silvered soft copper plate with folded edges which fits over a standard 5 x 7 chassis whose lips were filed off. This construction permits bringing the interstage shields in very close approximation to the sides of the chassis. Silvering of the copper plate, partitions, and coils was done using a preparation called "Pure Silver Plate"* This material provides a very satisfactory and inexpensive method of silver plating and has many applications in the ham shack. This material is poisonous and can only be secured through a pharmacy. It is easily applied, if directions are followed. The plate and partitions are individually drilled and plated before assembling.

The final oscillator coil and trap, as well as the mixer inductance circuitry, were prefabricated and mounted on Tectronix ceramic tie point units which make neat and rigid assemblies. The neutralizing inductance was mounted on the rf amplifier shield using a standard tie point as a standoff insulator which isolates it from ground.

*V. Burkinshaw Co., P. O. Box 192, Vista, Calif.

Amplifier

The rf cascoded amplifier circuit was slightly modified from that described by W2ZHI in that 18K plate resistors were used, as recommended by the manufacturer, rather than potentiometers. The socket of the first 7077 is modified as illustrated because of its grounded cathode configuration. Shielding is provided between stages with feed through bypass condensers. All heater and plate leads are shielded and bypassed. While no button bypass condensers were empolyed, leads from the bypass condensers used were cut to negligible length. Provision for lifting the cathode of the first rf stage off ground, as well as breaking the B+ to the rf stages and mixer was incorporated using a miniature relay.

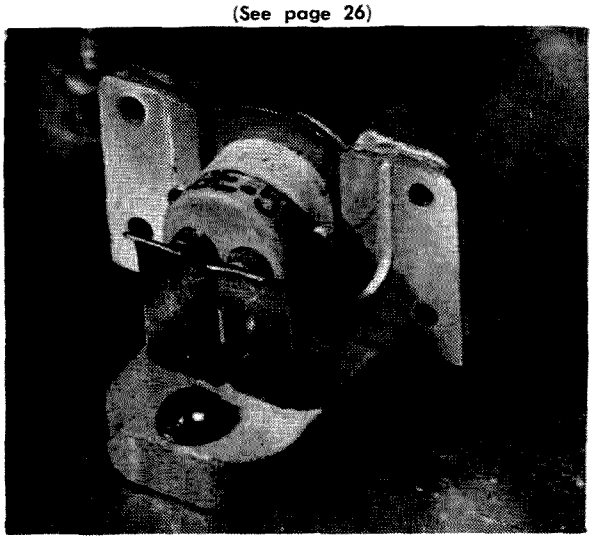
Mixer

The mixer is an Amperex 6688 high gain pentode. This tube has been used as a mixer in other circuits, and is superior to any other pentode tried. This is a premium tube. The gain of the rf amplifier is enough to provide adequate quieting. The constants used are different than those employed by DL3FM but provide 3 volts of cathode bias which places the tube at a favorable point of its transfer characteristic curve with 150 volts on the screen and 250 volts on the plate.

Oscillator

The oscillator section employs a fundamental crystal at 7222.22 kilocycles which brings the frequency out through the multiplier very close to 130 mc for 14-18 mc intermediate frequency. This circuit is simpler than that employed by DL3FM but with the incorporation of the 130 mc trap produces satisfactory injection with no

(See page 26)



Detail of modification of Jettron socket necessary for the first rf stage. The ground leafs are cut off flush with the base of the socket with sharp cutters. This makes the grid conection loose in the socket but this constitutes no problem. The sockets are Catalog #8670, Jettron Products, Inc., Route 10, Hanover, New Jersey.

(Ant. Switch from p. 84)

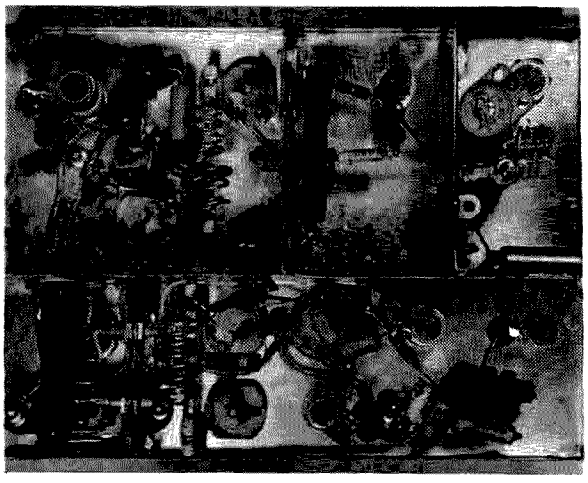
on a ¾" square, 1" high ceramic insulator post. The connection to this ferrule is a ¼" strip of copper slipped between the cable clamp and the ferrule and soldered to the antenna SO-239. 4-40 brass nuts and lock washers secure the soldering lugs to the other two switch contacts and 16 gauge bare wire connects these to the other two receptacles. Extreme care should be used to avoid breaking the glass to metal seals of the switch.

A 1-¾" length of ¼" Teflon rod is used as the actuating arm for the vacuum switch. The insulating qualities are superb and the rod is flexible enough to insure positive contact without placing undue strain on the switch. One end of the rod is drilled to a depth of ¾" with a #31 drill and the other end is slotted to accept an iron armature plate. One of the discarded relay armatures may be used and the rod and plate drilled to pass a #2 machine screw which will securely hold the armature in place. Very carefully push the drilled end of the Teflon rod on the exhaust tubulation of the switch. The crimp in the tubulation may be held with long nose pliers during this operation. Carefully orient the armature plate between the relay poles. If required, loosen the mounting screw of the ceramic post and position so that, when the contact is centered, the armature is centered between the poles.

Wire the balance of the unit, except for R-1 and R-2, and connect a jumper between pins 1 and 2 of J-1. Connect a 1,000 ohm adjustable, wirewound resistor, set for maximum resistance, in place of R-1. Apply power and adjust the resistor for 28 volts across the coil of RL-1. Remove the resistor, measure the value and install a 10 watt resistor of the nearest stock value for R-1. Remove the jumper from J-1 and repeat the procedure to arrive at the value for R-2. A 5 watt resistor will probably be adequate in this location. Key the unit and observe operation. The switch contacts should make just before the armature seats on the magnet poles, with the flexibility of the Teflon rod taking up the excess travel. If all is well, mount the plate on the chassis, using #6 sheet metal screws. If desired, brackets may be attached to permit mounting of the unit. Alternatively, the chassis may be mounted with screws through the top before the component mounting plate is attached.

The completed switching unit should cost less than a heavy duty coaxial relay and its performance more than justifies the construction effort. As described, the relay will function up through 30 megacycles without introducing noticeable discontinuity in the transmission line. The added bonus of quiet, dc operation and the ability of the unit to withstand considerable abuse make this a very worthwhile project.

.....W4WKM



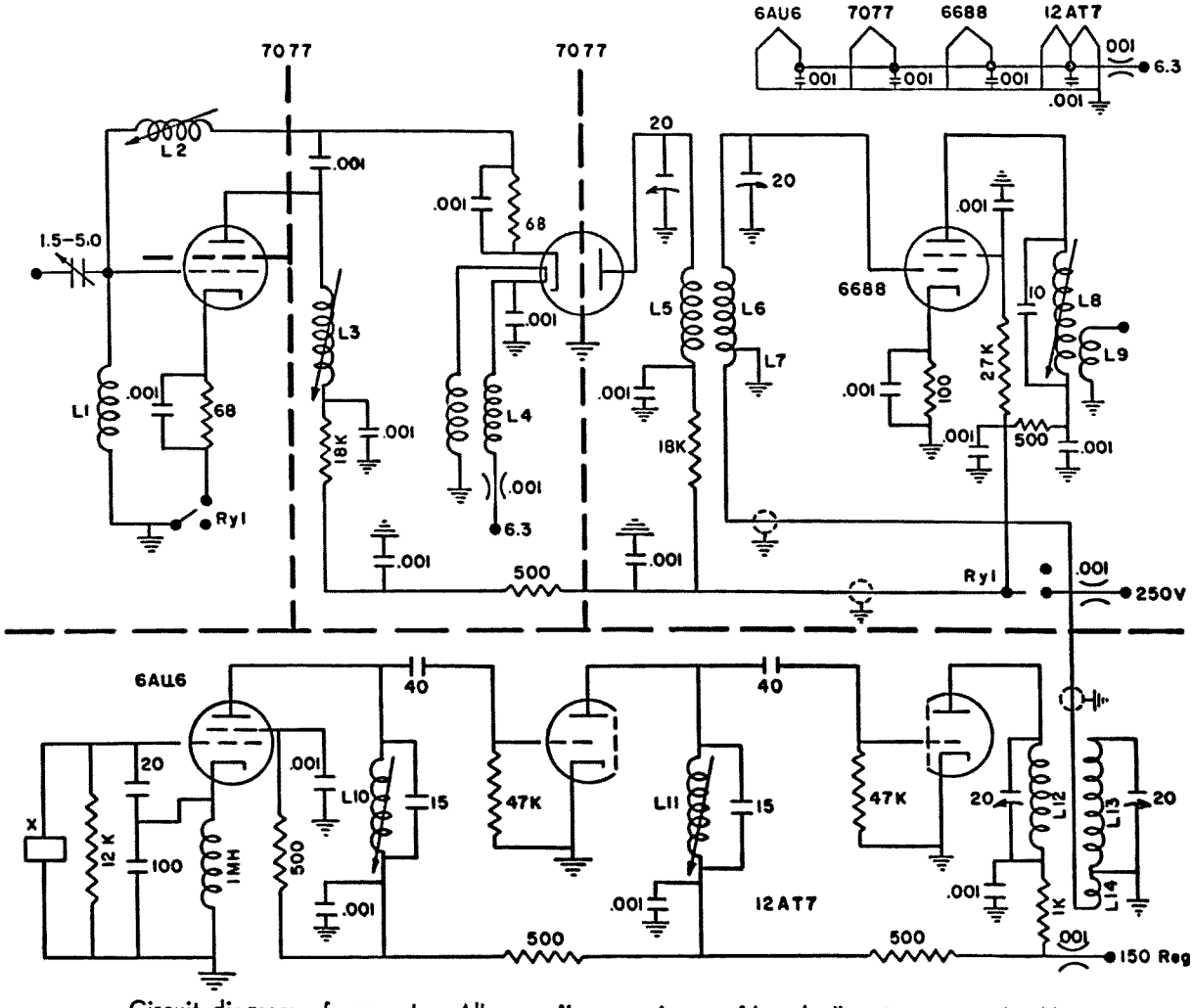
Converter from below: shows general position of components and shielding. Converter could easily be made smaller than 5x7 size.

evidence of spurious frequencies. The International Crystal Company circuit recommended for crystals operating on their fundamental frequency could be used here for more precise positioning of the injection frequency.

Adjustment

All tuned circuits were dipped and adjusted in the circuit with tubes in place but without voltage. The plate inductance of the first rf stage tunes very broadly and when it is adjusted to dip between 144-148 mc needs no further attention as positioning of the slug has no measurable effect on operation. The plate coil of the second rf amplifier and the grid coil of the mixer stage are slightly staggered and the plate coil of the mixer peaked for approximately a 1 mc portion of the band. The gain of the converter is such that adequate gain is obtained over the entire two meter band by adjustment of the rf gain of the communications receiver used. Swamping of the plate coil of the 6688 with 5K resistor can be used if more uniform coverage of the band is desired. The front end is adjusted for minimal noise by removing the heater voltage of the first 7077 and adjusting the neuterizing coil and input capacitor.

The oscillator chain is quite straight forward and is adjusted for maximum output. The trap is adjusted for 130 mc and its point of reso-



Circuit diagram of converter. All capacitors are in mm fd and all resistors may be ½ watt, although several 1 watt resistors were used in mixer circuit. All bypassing in R. F. circuit is done with shortest possible leads. Button capacitors may be preferable.

nance is quite noticeable on an incoming signal.

This converter, when tested with an accurately calibrated rf tight voltage source, gave a very noticeable signal with less than 0.1 microvolt input. There is very little tendency for overload except from a very powerful local transmitter and there is very little evidence of cross modulation. The noise figure was not measured but the gain is such that the rf gain of the communications receiver is kept reduced and even very, very weak signals pop out as if there were squelch action. . . . WA6EWV

References

[1]Coffey, William H. W2ZHI **7077 RF Amplifier for the 144 Megacycle Band** G. E. Ham News. January-February 1959.

[2]Lickfeld, Dr. Karl G. DL3FM **A Six Tube European Style 145 MC Converter** CQ. November 1960, page 38.

Coil Table

L1—4 turns #18 copper silver plated ⅜" i.d. Approx. ½" long.
L2—0.76 uh—10 turns #22 enamel close wound ¼" iron slug.
L3—4 turns #18 ¼" iron slug. Approx. ⅜" long.
L4—R F C bifilar filament choce 2 strands #26 enamel 1½" long on ¼" plastic tube or rod.
L5—4 turns #18 copper silver plated ⅜" i.d. Approx. ½".
L6—3 turns #18 copper silver plated ⅜" i.d. Approx. ½".
L7—1 turn #18 insulated wire at cold end of L-5.
L8—20 turns #22 enameled close wound ⅜" iron slug.
L9—1 turn #20 insulated wire cold end L-7.
L10—14 turns #26 enamel close wound (Triples).
L11—10 turns #26 enamel close wound ¼" (Triples).
L12—5 turns #18 ⅜" i.d. Approx. ½" (Doubles).
L13—5 turns #18 ⅜" 2.d. Approx. ½".
L14—1 turn #20 insulated wire cold end of L-13.

TROUBLE ON SIX?

Solution: MAVERICK II. This is a combination low pass filter and power indicator which is designed expressly for six meter use. The low pass filter has nine individually shielded sections and five tuneable stages. This results in exceptionally low insertion loss (less than 1 db) and a high attenuation of harmonics (35 db rejection of harmonics of 8 mc crystals and other spurious signals in the Channel 2 band). Will handle up to 400 watts at the antenna. The power indicator plugs into the filter for remote power reading (supplied with a four foot cable) calibrated in watts. Size: 4" x 4" x 4½".

Price: **$34.75**

Other Units:
Maverick (same, but no power meter) **$16.95**
Model F810 (5 filters, 80-10M, 1 KW) **$24.95**

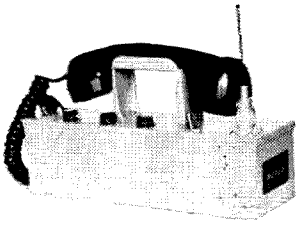
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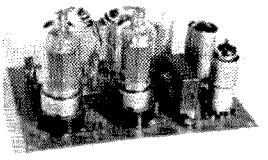
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See *Article page 10, this issue.*

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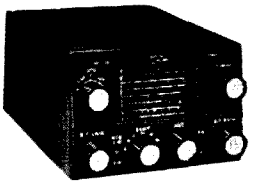
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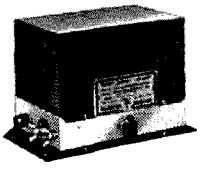
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PMR-8 RECEIVER
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M-1070 POWER SUPPLY
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(M-1071—Power Supply in kit form.)

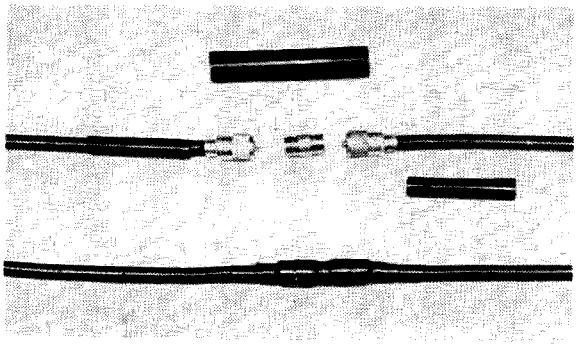
Manufactured by
MULTI-PRODUCTS COMPANY
21470 COOLIDGE HWY., OAK PARK 37, MICH

Photo Credit: Morgan S. Gassman, Jr.

Shrunk on Protection

Although not exactly new to the industry, many amateurs may not be aware of the many applications of shrinkable plastic tubing. Alpha Wire Corporation manufactures a line of this product known as "ALPHLEX" which is available through major distributors. This tubing is made from a modified, irradiated, polyolefin base plastic that is thermally stable. The tubing is supplied in expanded form and a size should be selected to just fit over the object to be covered.

Controlled shrinkage to the predetermined size occurs within 7 seconds when the tubing is subjected to temperatures between 275 and 300°F. Heat may be applied by an oven, proximity to a heating element, hot air gun (electric hair drier?) or by open flame if care is exercised.



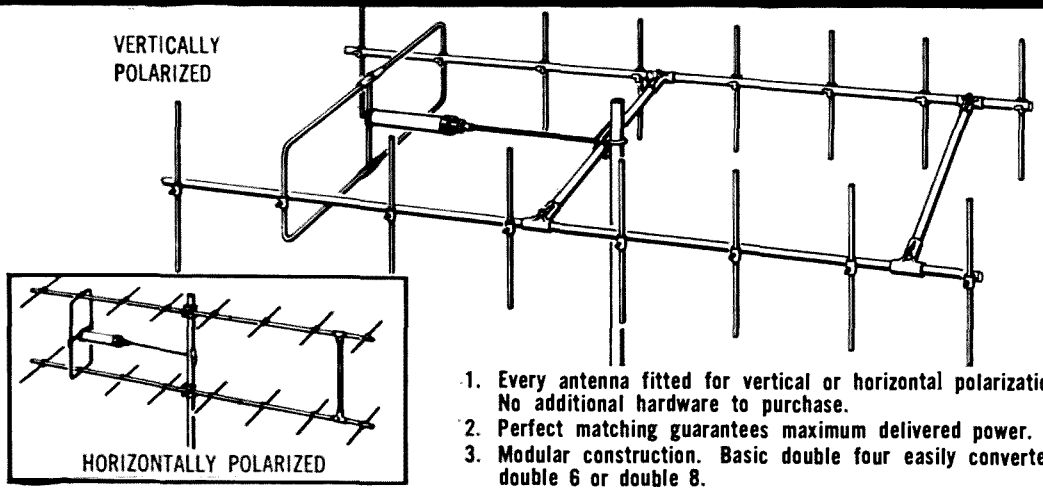
Alpha Number	Size	Before Shrinking Min. I.D.	After Recovered I.D.	Nom. Wall Thickness
FIT-275-5/16	5/16"	.500"	.334"	.025"
FIT-275-7/16	7/16"	.693"	.462"	.025"

A typical amateur application is shown in the photograph. Two sizes of the tubing are used to weatherproof a UHF connector, coaxial cable junction. Characteristics of the tubing used are as follows:

Two sections of the 5/16" tubing are slipped over the cable and, after the PL-259A connectors are installed, pushed over the ferrules. A length of the 7/16" tubing is slipped over one of the cables and, after the PL-258 straight adaptor is installed, pushed over the junction. Exposure to heat (an oven was used in the example shown) shrinks the tubing to provide an insulated, weatherproof junction.

Space has not been taken to list the complete range of available sizes of this versatile insulation. A visit to your distributor or a letter to Alpha Wire Corporation will produce the required data along with information on other applications. ... W4WKM

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144S6	Double 6	13.0	22.0	20	29.95
144S8	Double 8	14.0	27.0	15	36.50
144S16	Two Double 4	15.0	18.0	25	46.50
144S32	Two Double 8	18.0	27.0	15	71.95
144S64	Four Double 8	21.2	29.0	9	143.50

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(ARC-5 from page 21)

Mount a 3-30 mmfd trimmer across the plate studs. Shunt the two 3 mmfd capacitors in the grid leads to the final with two 2 mmfd capacitors to bring the total capacity up to 5 mmfd.

To improve drive for 220 the following grid leak resistors should be substituted for the originals. Oscillator—82k, 2nd 1625—50k, first 832A—100k, final 832A—unchanged.

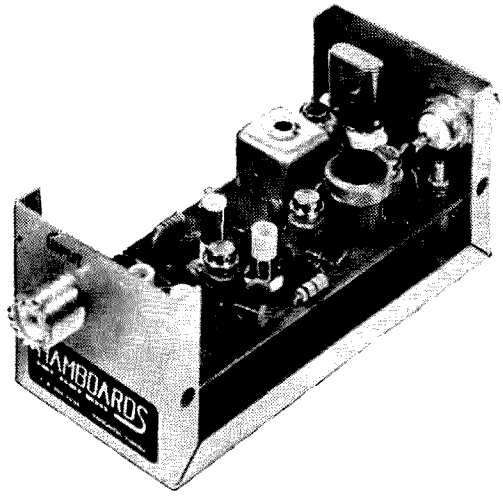
Table 1 gives the approximate frequency of each multiplier stage based on an 8 mc rock in the oscillator. As a final touch I gave the transmitter a two tone paint job, reversed the name plate on the front of the transmitter and put on the decals. The control box also got a spray of blue paint and the decals were added for a better appearance.

The rig is tuned by means of a 3/16" nut-driver and the coils are adjusted for maximum indication on the meter. These readings will be from half scale to full scale, depending on the internal resistance of the meter. The final is tuned for dip with the slug in the final coil at the front of the transmitter and loaded with the antenna coupling (loading) capacitor.

Excellent signal reports have been received with the T-23 and I am quite satisfied with its overall performance. By the way that 0-1 ma meter is a real rugged beauty and it costs less than two dollars. So, how about a trip to radio row to become one of the boys on VHF. See you on 220.



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2 METER CONVERTER, Xtal controlled, 4 db noise figure, 5 low noise VHF transistors. Requires 15 ma @ 11-15 VDC. Complete with instructions, $ 49.95

6 METER CONVERTER, Xtal controlled, 4 db noise figure, 4 low noise VHF transistors. Requires 13 ma @ 11-15 VDC. Complete with instructions, $ 44.95

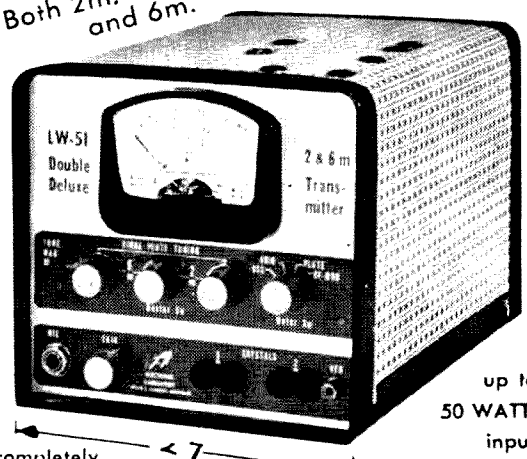
2 METER PREAMPLIFIER, 4 db noise figure, 21 db gain, only 1 x 2-3/8 inches for easy installation. Requires 2.5 ma @ 11-15 VDC. Complete with instructions, $ 12.95

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Four Layer Devices

IT is difficult to think of an electronic component for which hams have not found a use. Given a little information, time and a reasonable price, hams will find some use for almost anything. It is hoped that this article will provide a little information.

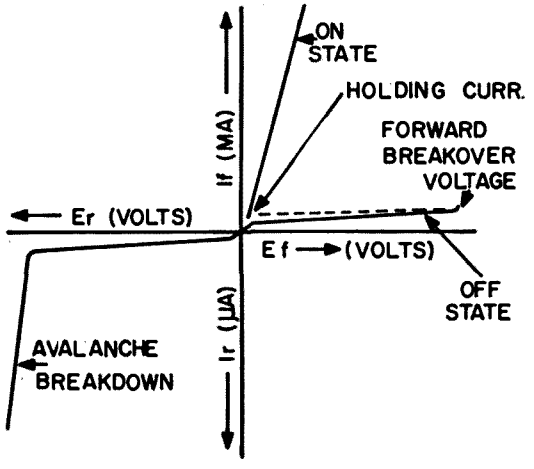


FIG. 1

Silicon Controlled Rectifiers (SCR) are not new, but now there is a family of devices (See Table) based on the SCR. The SCR is a semiconductor device that is similar to the gas thyratron. That is, it will remain in an "off" (non-conducting) state until turned "on" (conducting state) by a control signal. It will then remain "on" even if the control signal is removed. The SCR is turned "off" by reducing its anode current below the "holding" level (See Fig. 1). The devices listed in the table all resemble the SCR in theory and operation, but they have much greater firing sensitivity. Therefore, they are useful in low power circuits that are not within the capability of the SCR. Also, some of these devices are designed for control signal turn "off".

Compared to thyratrons these devices are smaller in size, more rugged, free of jitter, no filament, no aging effects and no firing instability. Also, their forward voltage drop is much lower than that of a thyratron. If used in place of a relay, they have no contact bounce, no arcing, no moving parts, high sensitivity and high speed operation.

The operation of these devices is best understood by using a two transistor analogy (See Fig. 2A). The collector of the NPN drives the base of the PNP, and the collector of the PNP drives the base of the NPN. This feedback loop has a gain equal to $\beta 1$ multiplied by $\beta 2$. The device remains in the "off" state as long as there is no positive gate signal, but when a positive trigger signal is applied to the gate the NPN is biased "on", causing its collector current to rise. The collector current of the NPN turns the PNP "on" and it in turn provides more base drive for the NPN. Both transistors are driven into saturation and the impedance between the anode and cathode (Fig. 2B) becomes very low. The gate signal is no longer needed because the PNP provides more than enough drive to the NPN. The device will now remain "on" until the anode current is reduced below the holding value (this can be done with a switch or a pulse). The functions of the two transistors are combined into a single PNPN silicon wafer. The curve in Fig. 1 is characteristic of four layer devices. Reverse voltages (E_R) cause only a few micro-amps of current to flow (I_R) until the avalanche breakdown point is reached. Forward voltages (E_F) cause only a few micro-amps to flow until the forward breakover voltage is reached. These devices will block either polarity voltage until turned on, then they will act as a diode.

The current gain of these devices is tremendous, 50,000 is practical. A representative gate signal for turn "on" is +.1 volt and 20 micro-amps (20 micro-watts). This gate signal might be used to control an anode current from a few milli-amps to a few amps at voltages up to 200 volts. Turn on time is usually a fraction of a micro-second.

The circuit in Fig. 3 can be used for direct control of current to a given load. Until the four layer device is turned "on" it will act like a few megohms of resistance, once it is turned "on" its impedance will drop to a low value (under one ohm at high anode currents) and current will be limited only by the load. If a regular dc relay is used for the load, it

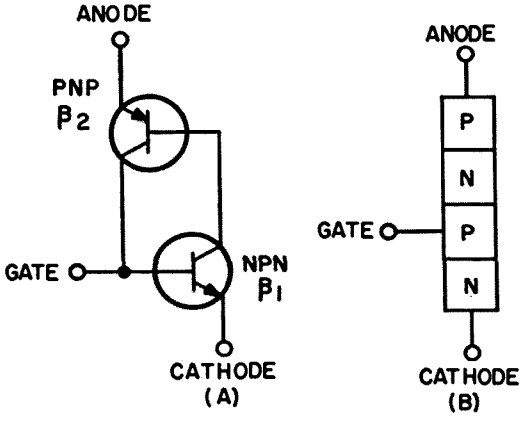


FIG. 2
a. Two transistor analogy of four layer device.
b. External connections to the silicon wafer.

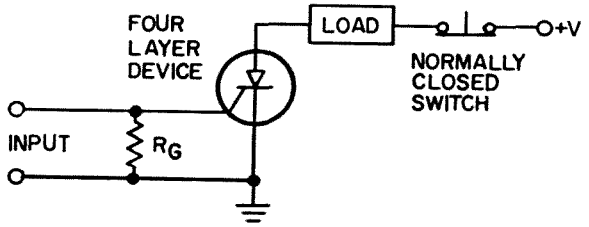


FIG 3

will be converted to a highly sensitive latching relay. The gate resistor (R_G) is for bias. Never operate a four layer device with the gate open. It is a high gain device and leakage current may cause "turn on" and possible self-destruction.

Four layer devices can be used as pulse generators, timing circuits, dc to dc converters, protective circuits (for those high priced bottles) and many other things. One might be used to replace the relay in an electronic keyer.

There are many potential uses for four layer diodes in amateur radio and it is hoped that this article will stimulate a little thought along these lines. For more information see the bibliography.

Bibliography

"Controlled Rectifier Manual," General Electric Company, Charles Bldg., Liverpool, New York.

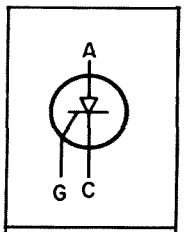
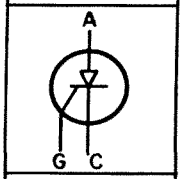
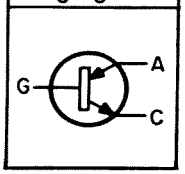
"Silicon Controlled Rectifier," Bulletin #AN-1356A, Transitron Electronic Corporation, Wakefield, Massachusetts.

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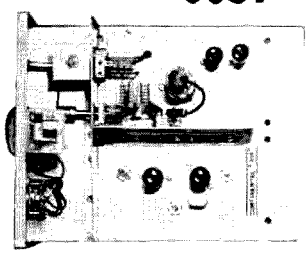
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"The Transwitch," Bulletin #AN-1357A, Transitron Electronic Corp., Wakefield, Massachusetts.

TABLE OF FOUR LAYER DEVICES

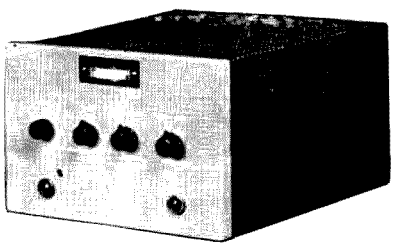
Name	Symbol	Description
Silicon Controlled Rectifier		Semiconductor device similar to a gas thyratron, acts like an ordinary diode that has been modified to prevent forward conduction until a small signal is applied to the gate.
Silicon Controlled Switch		Same as Silicon Controlled Rectifier except it is more sensitive (requires smaller gate signal) and designed for relatively low power levels.
Trigistor or Transwitch		Same as Silicon Controlled Rectifier except it is designed to be turned "off", as well as "on", by a control signal applied to its gate.

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DEALER INQUIRIES INVITED — CONTINENTAL ELECTRONICS, SUMTER, S.C.



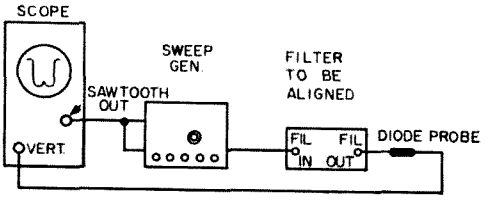
Photography by Linda Gridley

A New Broom

Dick Gridley K6JHJ
Edison Powerhouse #8
Auberry, California

MY attempts to build a crystal filter—and a stroke of luck—brought about the building of this piece of equipment. The unit is a sweep generator of simple design, with many uses.

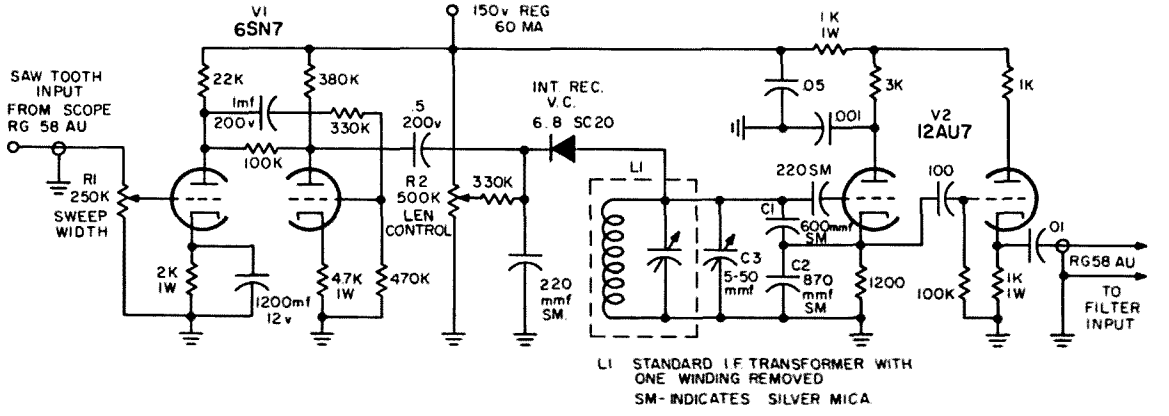
I, like many, started to build a single sideband exciter. With a light heart, a bucket full of FT-241-A crystals, and the available articles on crystal filters, I laid out a breadboard rig, grabbed the BC221 and a Hewlett-Packard 400D VTVM and immediately ran into trouble.



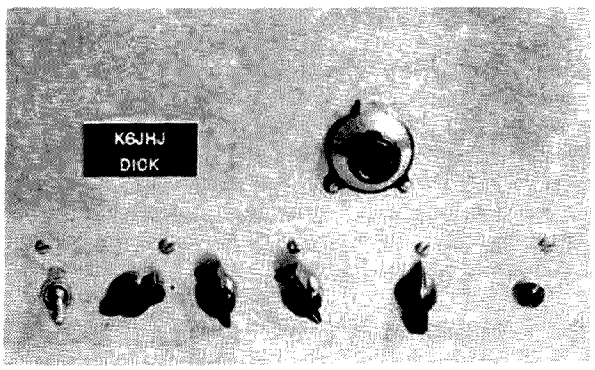
It seems the filter articles written to date are based on db readings using a receiver S meter. In using a precision VTVM I was not able to approach the shape factor or the final shape these fellows were getting using the receiver S meter. After attempting half lattice, full lattice, and a few others I was ready to give up. Enter the stroke of luck ———

On May 6th I went to the hamfest in Fresno and attended a lecture by Bob Fisher K6BGJ on the use of Vari-Caps—ala sweep generator. This was the answer to my problem. Bob's rig was quite elaborate in that he had built in his own sawtooth oscillator and was using the unit with a BC221. He suggested the use of the scope's sawtooth oscillator directly into the BC221 as an alternate. Not wanting to disrupt the accuracy of my BC221, and being inherently lazy, I took the easy way out. I built my own oscillator and used the sawtooth output from my scope.

The heart of the rig is an inexpensive item called the Vari-Cap by International Rectifier Corp. Two are discussed here, the 6.8SC20 and the 100SC2. The 6.8SC20, according to the manufacturer, will vary its capacitance from 50 mmfd at .1v to 2.5 mmfd at -200v. The 100SC2 will vary from 600 mmfd at .1v to 100 mmfd at -10v. These units each cost less than $3.00. The construction is not critical in any way, nor is layout a problem—just use good ham practices. Any power supply delivering 150 v dc at 60 ma regulated will do. The oscillator tank must be grounded and I did have some trouble until I removed the unused winding from the 455 *if* transformer used for the oscillator tank.

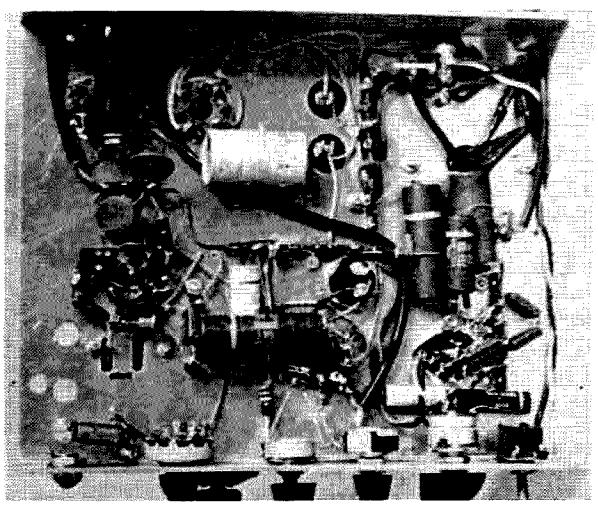


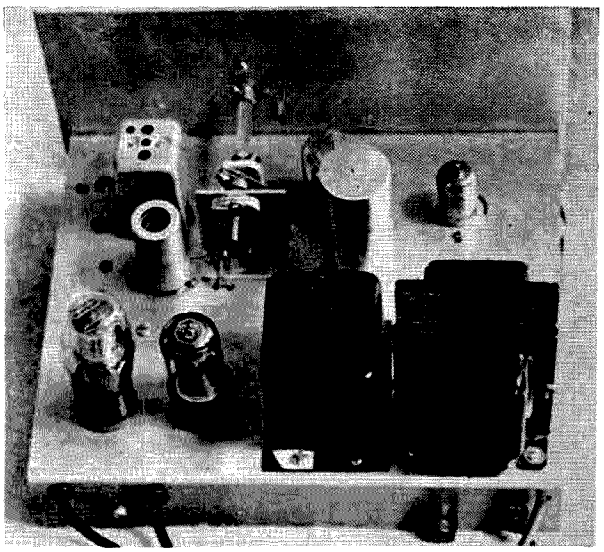
Sawtooth energy is applied to R1 which regulates the amount to be amplified by V1. R2 linear control merely puts a portion of regulated voltage on the Vari-Cap and thus sets the capacity of Vari-Cap close to its center, so the sawtooth pulse creates a linear frequency swing. This circuit gives about 6 kc sweep. I have used TV horizontal coils for L1 and increased C1 and C2 to .003 for 85 kc and 50 kc operation. However, to get enough swing at low frequency, the Vari-Cap was changed to a 100 SC2. For 200 kc to 10 mc the 6.8SC20 gives plenty of sweep.



A note here about scopes. Most of the average do not go below 15 cycles and the sweep rate should be about 10 cycles. Some do not have a sawtooth output jack. The sawtooth output can be picked off the sync circuit. I found the best point is on the feed side of the sync pot through a .25 mfd capacitor. Some scopes have a couple of jack pins to add capacity externally, some don't. You will find little trouble adding about .25 mfd across the slowest speed.

The use of the rig is simple. Plug the lead from R1 into the scope's sawtooth output. Couple the output from the cathode follower section of V2 to the filter input through a .001 mfd capacitor. The vertical input of the scope is connected to the filter output through an rf probe. Adjust R1 and R2 about ½ open. With C3 about ½ meshed, adjust the trimmer in the *if* can to put you in the ball park, and then use C3 for fine adjustments of frequency. Additional minor adjustments of R1 and R2 may be necessary. Of course, when used to align a receiver, the diode probe is unnecessary if the input to the scope is picked off of the diode detector. It goes without saying that it is necessary to plot an index for the scope bezel so that a ready reference is available for band pass width and depth of skirt.





Some one now says "This is just like setting ye old TV—*if* band pass." That it is. The only difference here is the frequency and the sweep generator cost was junk and $5.00.

The unused switch, shown in the photo, was installed to select one of three frequencies. However, this rig has been used on about six. I don't think I ever will decide which three to use. The unidentified tube is a 6U8 used as a 1 kc audio oscillator with cathode follower output.

I hope you will build this gadget, as it is like another hand around this builder's shack. If you do build it, you can bet the next time you shape a band pass—be it a filter for the exciter or the *if* in the old inhaler—it will be right. You might want to try just once more to build that crystal filter, and if you do, it will be a shoe-in. . . . K6JHJ

(Linear from page 37)

the goal of this project is to obtain a respectable signal for the least expenditure of money, this would be defeating my purpose, unless the changes were simple and inexpensive.

Before operating a unit such as this, one should run a series of tests to determine just what limitations should be placed on the unit in each class of service.

The author is well aware that nothing described here is unique; yet, seeing another angle and a different configuration helps those who are contemplating building a similar unit.

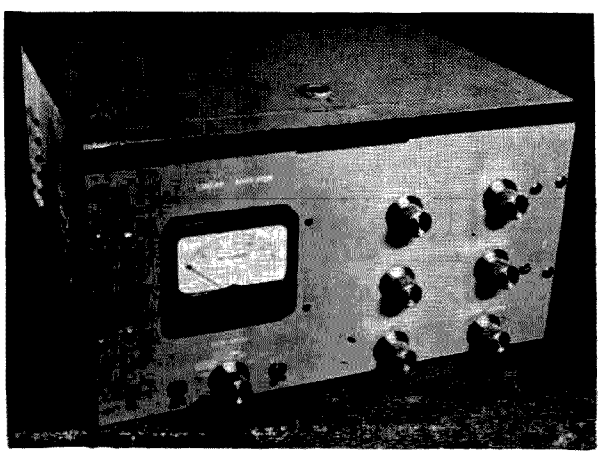
This combination can be heard on most any band, at any time, providing a barrel of fun. Good luck. . . . W9CJS

All Band Linear

David Gauger W9CJS
3900 Bluebird Lane South
Rolling Meadows, Illinois

MANY people shy away from the advantages of SSB because of the high cost involved, and to be sure, one can spend the proverbial "potful" on SSB equipment if he so desires. The setup described here has been in use for the last two years at this station and has evoked nothing but complementary comments by other operators, and yet its cost and complexity are little more than the average AM setup. It is designed primarily for SSB and CW operation but does an admirable job on AM as well.

The entire arrangement could be duplicated for considerably less than $200. If one is adept at scrounging various parts from surplus gear, he might conceivably reduce the investment by a large amount; however, it is not intended that anyone copy this arrangement exactly as it is. Rather, I would hope that I can convince some of the skeptics that it doesn't take a fortune in gold to put a very respectable signal on the air, both in quality and S units.



Front view of the amplifier in finished form. Below the meter are the power switch, the meter selector switch and the plate power switch. The other six knobs are as follows: top left to right, band switch, and plate tuning; middle, a dummy knob on the left and the output tuning on the right; bottom, CW / driver barefoot / final switch, and fixed capacity output tuning switch. The panel is 1/8 inch aluminum in smooth grey, 10½ x 19 inches. The knobs are the author's design and were turned from 1½ inch aluminum turning stock.

The setup is simply a vfo into a SSB generator into a final amplifier. The vfo used is the old HT-18. For the benefit of those who may be unfamiliar with the HT-18, it is a self contained VFO providing several watts of power output directly on each band, 80 through 10 meters. Because the SB-10 requires drive on the same band that output is desired on, the HT-18 is a natural choice for a vfo. How is the frequency stability you ask? The stability of my HT-18 is excellent. It will "sit" right on my crystal calibrator for very long periods of time, even on ten and fifteen meters, and it is a stock model in that no additional compensation or modifications have been made. I have never had a complaint of drift by any station in the two years that I have operated SSB.

The vfo will drive the SB-10 to rated output on all bands. Certainly the SB-10 needs no introduction. Perhaps you have heard criticisms of various troubles in the SB-10. Let me say this, if one follows all the simple suggestions for its operation that the Heath Company provides, it will provide a good clean signal with very adequate carrier and unwanted sideband suppression.

The final is simplicity itself. It consists of four EL-34 pentodes in parallel used in a very common grounded grid configuration.

With 1000 volts on the plates, one can run 250 watts pep on the lower three bands and about 150 watts pep on 15 and 10 meters. On CW one can run 300 watts input on all bands.

Circuit Description

On the final amplifier chassis are included a low voltage supply for the SB-10, the RF section, and its 1000 volt power supply. The low voltage supply provides slightly over 300 vdc at a capability of 125 ma. The output capacity is 40 mfd as recommended, to help improve the linearity of the driver output.

The final consists of four EL-34's with all grids grounded. No fixed bias is used. With this arrangement, the total final idling current is about 80 ma and provides adequate load for the HV supply so that no bleeder resistor was used. The cathodes of the EL-34's



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are tied together and grounded through a 2.5 mh rfc. Drive from the SB-10 is applied directly to the cathodes and no input tuning is used or needed. The plate circuit uses a standard pi section comprised of a 250 mmfd plate tuning capacitor, and a three section output tuning capacitor of about 1100 mmfd. An additional switch is used to add fixed capacity if needed. The final tank coil consists of two coils, one for the lower three bands, and the smaller for fifteen and ten meters. The larger coil is an Illumitronics vari-pitch pi-dux, #2008D5 and is seriesed with a smaller coil of 6 turns of #12 wire, 1¼" diameter 2 inches long. For 40, meters, the large coil is tapped 15 turns from the bottom end. On 20 meters, the larger coil is tapped 21 turns from the bottom. For the top two bands, the builder must simply experiment to find the best taps. The author's taps were as follows: fifteen meters, tap at 2½ turns from the lower end of the small coil and for 10 meters, tap at 4½ turns from the bottom end.

The first high voltage power transformer used went up in a cloud of dense acrid smoke. Evidentally it had picked up some moisture and the author's baking hadn't done the job. The only replacement was a husky surplus unit giving 1280 volts ac across the secondary with a tap at about 250 volts from one end. There was no center tap, so a bridge circuit was contemplated. Since a bridge circuit is expensive, and I was trying to build the unit on a teacher's salary, I decided to try half wave rectification and prove to myself that it would not work, before going to the trouble and expense of incorporating a bridge circuit. Much to my surprise, the half wave circuit works. and does so, much better than I ever dreamed it would. Believe it or not, there is no trace of ripple on my CW note, even when running 300 ma to the final. The plate voltage drops from 1150 with 80 ma load to 1000 volts with 250 ma load. The familiar two tone test on the final shows that the final begins to flat top at about 250 ma.

Construction

A chassis of considerable size was needed to provide room for all necessary components. The chassis used is a Cadmium plated steel job of dimensions 17" x 14" x 2". The panel is ⅛" aluminum, sprayed grey. The cabinet is a surplus item painted grey to match the panel. The knobs were turned out of 1½" aluminum turning stock, and are the author's design. The front panel meter is a Simpson model 29 having a basic movement of 1 ma. The 300 ma scale was obtained directly from the Simpson people at a cost of a little over $1.00. The meter is lighted by two small sub miniature lamps placed through two holes drilled through the meter body at the top. It is recommended that the meter be removed

from the case when this is done in order to remove drill chips. The illumination is very pleasing and serves as a pilot light. The meter is switched to read cathode current, high voltage, forward and reverse indications from the built-in Monimatch, and rf voltage across the antenna connection. In each application, one side of the meter is grounded.

A function switch is placed on the front panel which switches the SB-10 directly to the antenna for local operation, a second position for normal amplifier operation, and a CW position where the output from the vfo is bypassed around the SB-10 to drive the cathodes of the amplifier, directly.

A coarse loading switch was found to be almost unnecessary. This amplifier can be loaded to full output into a 50 ohm non reactive load on 80 meters, without the use of the fixed capacitors.

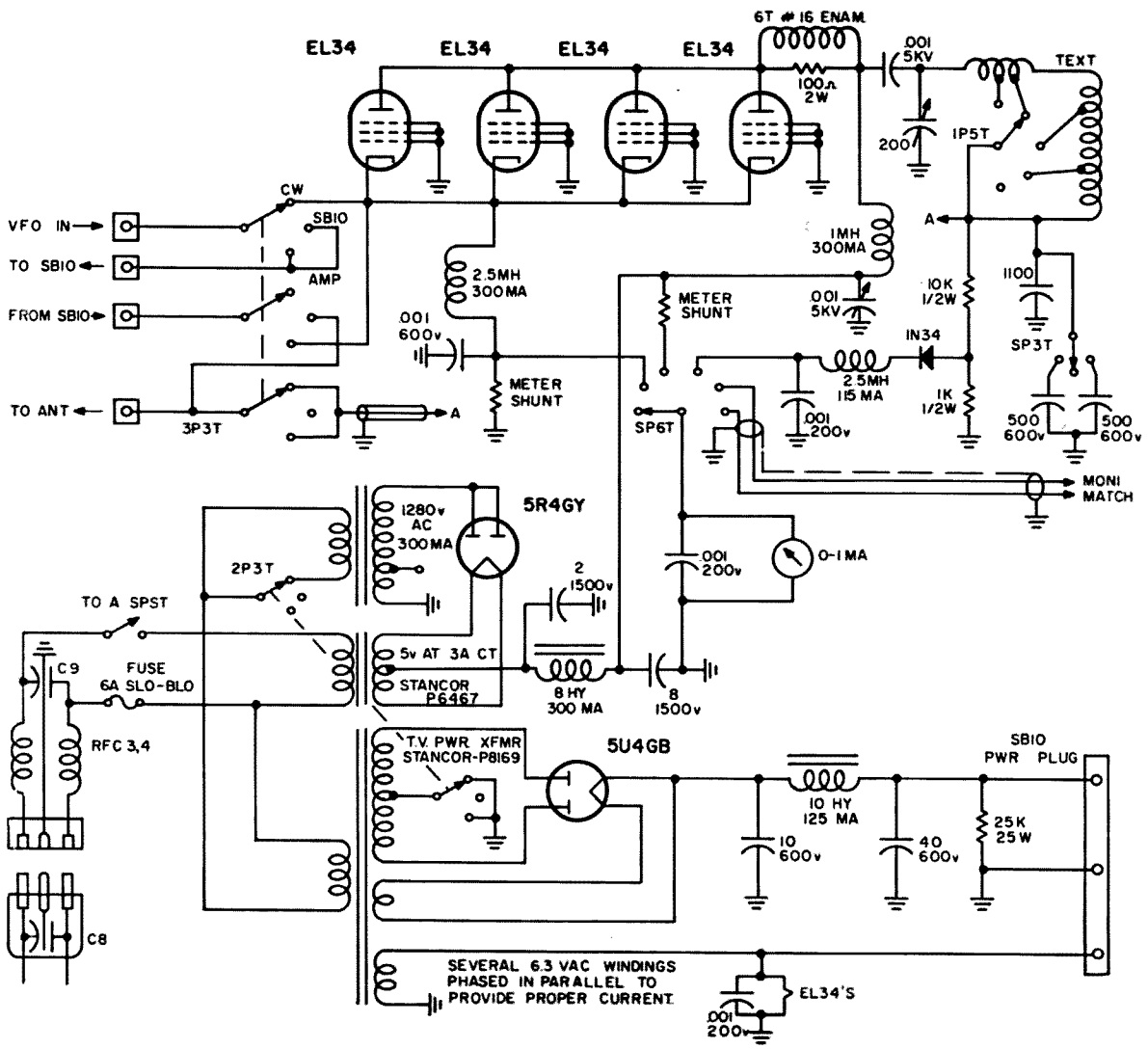
The back apron of the chassis includes a Jones plug connection for the ac power. The ac line is bypassed both inside, at the terminals and outside, within the shell of the connector. The line is filtered by an rf choke in each lead. Four coaxial connectors, the SB-10 power socket, and a fuse post complete the rear components.

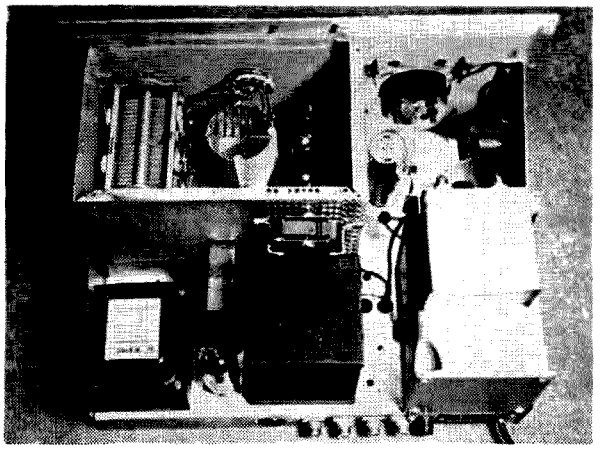
A Monimatch was constructed and mounted on the back of the cabinet. Its connections are made through a three conductor shielded cable which emerges through a grommeted hole in the back chassis apron and plugs into a three circuit jack in the bottom of the monimatch box.

Up topside on the chassis, the rf shield cage encloses the final tubes, tank circuit and tuning capacitors. The plate tuning capacitor is a double section unit of about 150 mmfd per section with both sections paralleled. The output capacitor is an old broadcast radio job having three sections of 365 mmfd each, paralleled.

On the front panel, to the left of the meter switch is the main power switch. To the right is the plate switch. It is a center off toggle switch wired such that when in the down position, only the low voltage to the driver is on, and when in the up position, both low and high voltage supplies are on.

No values in the schematic are critical, save only the meter shunt resistances which I pur-



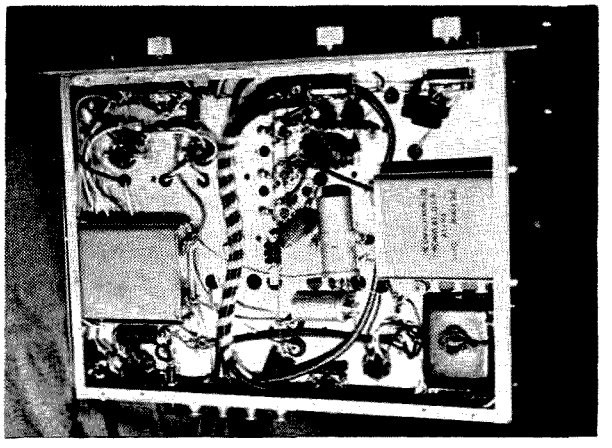


Top rear view of the amplifier with the top of the final amplifier rf cage removed to show interior detail. At the rear left is the low voltage power supply except for filter capacitors which are mounted below. At rear center is the H. V. filter choke, and to its right is the H.V. power transformer, on top of which is mounted the input filter capacitor. Note the cooling fan motor above the choke. Within the cage one can see the final plate tuning capacitor to the left. It hides from view the triple section output capacitor which is directly below. The final tank assembly and banndswitch can be seen along with the extra coil for 10 and 15 meters. At the front right are the H.V. rectifier and its filament transformer. The two small holes above the meter are to allow the two small lighting lamps to be inserted above the meter scale.

posely have not given values for. I feel that most people will use meters having different characteristics, and in that case different shunt values are dictated. The amplifier has not been de-TVI'd to any extent. The final amplifier has been enclosed in a cage, the line has been filtered to prevent any great amount of rf getting back into the house wiring, and a parasitic suppressor has been used in the final plate lead. Other than that no precautions were used, and yet no sign of TVI is seen on a portable TV set which is operating right next to the amplifier.

Adjustment

Operation of the combination is simplicity itself. The filaments are allowed to reach operating temperature and the plate supplies are turned on. The final cathode current should idle around 80 to 100 ma. With the vfo, SB-10 and final switched to the same band, say 75 meters, carrier is inserted by detuning one of the carrier null pots on the SB-10. As the SB-10 is peaked for maximum output, the cathode current should rise to between 250 and 300 ma. Next, the meter switch on the amplifier is turned to the forward position on the monimatch and the final amplifier controls are tuned for maximum output. Null the carrier on the SB-10, and turn up the gain. You are the proud possessor of several hundred watts of clean sideband power. One caution, watch carefully for signs of overdrive in the SB-10. If your carrier null is hard to obtain or keep, once it has been reached, chances are that you are driving the unit too hard. In this case, open up the HT-18 and detune the output slightly until the SB-10 is no longer overdriven. This may be necessary on several bands, as the HT-18 puts out a real wallop for a vfo unit. While the vfo is open, remove the wires from the tune switch on the front panel and parallel the switch across the keying terminals at the back. This facilitates zeroing in on frequency without placing any carrier on the air.



Bottom view of the amplifier, panel to the top. The two large capacitors are each 4 mfd at 1500 vdc and are parallel. They are the HV filter capacitors. The two small cylindrical capacitors are the LV filters for the SB-10 supply. At the bottom left one can see the AC line chokes and bypass condensers mounted near the Jones connector and fuse post. The four coaxial connectors are used as follows: from left to right, RF in from the HT-18 eco, RF to the SB-10, RF from the SB-10, and amplifier output to the Monimatch. In the upper left corner are the meter switch and HV rectifier socket. At top center are the four EL-34 sockets. At the bottom right is the LV power supply. The chassis is Cadmium plated steel 14" x 19" x 2" and was "rescued from the junk box."

There are several points in the design of the unit that may draw argument from some readers who are more technically proficient than I. Among them, the most obvious would probably be the use of a condenser input, half wave rectifier circuit. All I can say is that it works and works well. No doubt the unit would be linear to a greater power rating if a different power supply were used, however linearity is determined by a great many things, and in my case, the amplifier begins to flattop at about the same time the SB-10 begins to do so. Thus, to run more peak power would require several design changes. Since

(Turn to bottom of page 33)

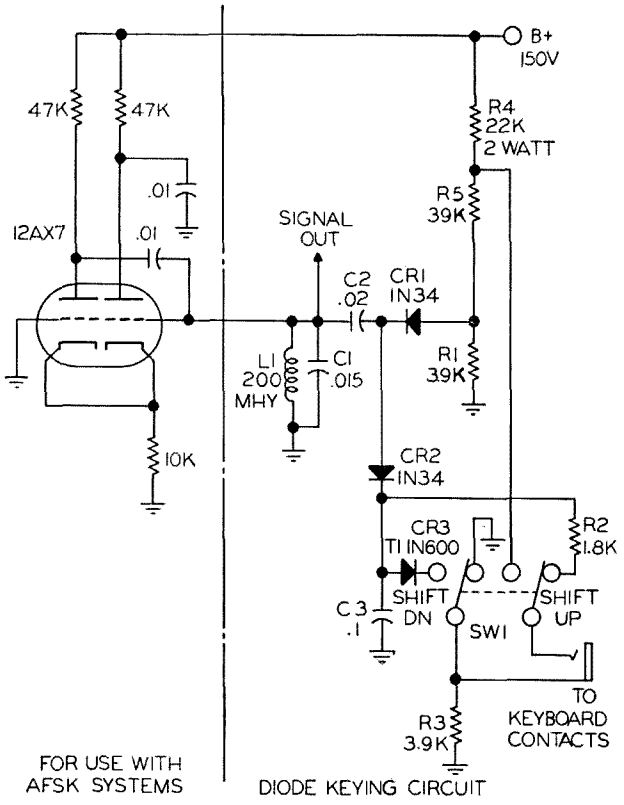
FSK Without Relays

Ted Hart W5QJR

Several articles have appeared in Ham magazines illustrating diode keying circuits for the FSK oscillator used in RTTY stations. By extending the idea, all the relays (except selector magnets) in the RTTY system may be eliminated. This includes the formidable polar relay, a device that is almost as hard to use correctly as it is to obtain.

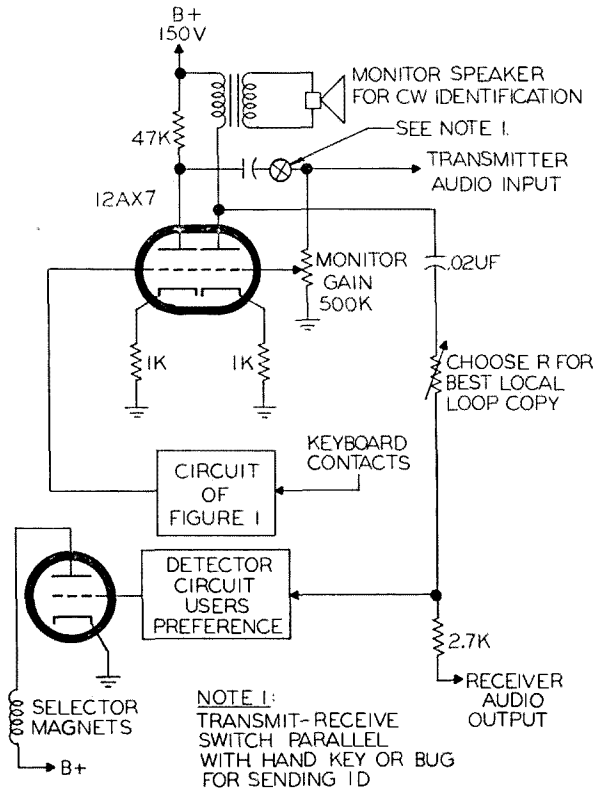
Since most of the RTTY stations use a vacuum tube keyer for the selector magnets, the only remaining use for the polar relay is to provide the capability of shifting oscillator frequency up or down to achieve a function paralleling that of upper or lower sideband for SSB stations. This function can be achieved with diode keying, thus eliminating all the reasons for using a polar relay. Even the cost of the three diodes required is nominal and the units are available out of most junk boxes and at all electronics parts houses.

Fig. 1 is a schematic diagram of the diode keying circuit. The dashed line separating the oscillator tube and the tank circuit indicates



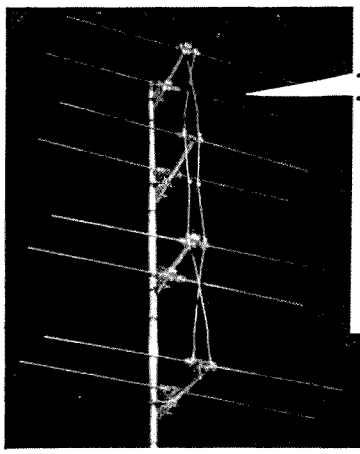
that the circuit may be used for either an AFSK system with the values shown or L1-C1 may be components of the VFO tank circuit for those who prefer keying at the rf frequency. The values shown on the Schematic for L1-C1-C2 are approximate only and should be selected for 2125 and 2975 cps. For keying the VFO choose L1-C1-C2 to provide 850 cps shift at the frequency desired.

Referring to the schematic diagram, Fig. 1, the switch is shown in the more conventional shift up condition. The keyboard contacts are closed in resting condition, causing a current to flow through diodes CR1 and CR2. CR2 is gated closed and places C2 in parallel with L1-C1 to cause the oscillator to be at the lowest frequency, F_L (2125 for AFSK). The .1 mf capacitor may be considered a short circuit for the frequencies chosen. When the keyboard contacts open, for a mark condition, no current flows and CR2 is gated open. C2 is removed from the tuned circuit and the frequency is determined by L1-C1 only as the higher frequency, F_H (2975 for AFSK).



With the switch positioned to the shift down position and, since the keyboard contacts are closed for space, a positive voltage will be applied to CR3 to prevent current flow through the diodes. The circuit now rests at F_H. A mark condition opens the keyboard contacts and allows current flow through CR2 causing the oscillator to shift to F_L.

When used with a 150 volt power supply current flow through the diodes is limited to 2.5 ma by the bleeder resistor networks, R1, R3, R4, and R5. R1, R2, and R3 were chosen to provide proper frequency shift in both switch positions, eliminating circuit interactions. CR3 should be a silicon diode, while CR1 and CR2 should be germanium diodes. Typical



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Cush Craft 621 Hayward Street Manchester, N. H.

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types are shown on the schematic but most available units will work satisfactorily.

Fig. 2 details the means for obtaining local loop copy. V2 provides input to the detector circuit from the AFSK oscillator and isolates the transmitter input from the receiver audio output. If selector magnets are keyed through a vacuum tube, no relays will be required in the system.

If the VFO is shifted, the receiver will serve as the local loop in the same manner used to monitor CW signals when a monitor is unavailable. . . . W5QJR

Letter

Dear Staff:

Three days ago a friend let me glance through your October issue. There I saw your article, "A Like-New Mixer Circuit." Since my old Super Pro was starting to feel its age I figured that this might be just the tonic.

So, after stuffing the mag. into my coat pocket when my friend was occupied with that ZL station he needed, I excused myself and hurried home to see if at last this might be my solution to that high noise level, low signal level, etc.

Using a war surplus LP-5 signal generator to set an "S" signal of 2, I found that I just could pick out the signal through the noise. So out came the soldering iron, and the rest of the elements.

The conversion itself took a bit over one hour. Most of the time was spent looking for the 4.7K resistor.

After alignment, the set was turned on and it was found that a full 3 "S" units was gained. The conversion made was for the 12AT7. However, a 12AU7 produced just under 2 units and a 12AX7 produced just under 3 units.

All in all, the time spent was more than justified in that the noise level that had bugged me so before now was in the background.

Going a bit further, I pulled the first RF and replaced the circuit with a cascode circuit. After alignment, a reading was taken and it was noted that with a 12AT7 in the circuit I could pick up only 2 more "S" units. So, I pulled the second RF tube and replaced it with another cascode circuit. After I was able to kill the oscillations that kept creeping in and re-re-aligning the front end, I had gained another 2 units. Not only that, but the noise had retreated to the point of "just barely"!!!

Well, I have returned the magazine that I made off with, and have had several comments from visitors as to the FB way my "OLD WARHORSE" sounds. And now I'd like to thank you for printing the article. It sure works good. And best of all, it makes an old RCVR "LIKE-NEW."

Jim Whitfield K6BHN

wanted

RADIO OPERATOR—TECHNICIANS

The U.S. Government has a continuing requirement for single and married men between the ages of 20 and 30 with radio operator-technician experience. Individuals with less than minimum required experience can qualify for training. Persons with past applicable experience who for some time have been out of touch with this type of activity will be trained. Assignments are overseas at interesting foreign posts.

Starting annual salaries, which will be determined by the applicant's experience and ability, range from $4830 to $5885. Normal promotional progress within this salary range may be expected when quality of performance dictates. Beyond this latter level advancement possibilities exist on a selective and competitive basis. Standard government allowances are paid in addition to the salary.

A variety of foreign posts is available. Rotation of the employee and his family from post to post is accomplished in accordance with standard government regulations and usually involves tours of 24 months duration at each post followed by Stateside leave between assignments. Work is challenging and varies from post to post. If you are in good health, not subject to military draft, and are interested in the above openings, please write, giving us the following information:

1) Name, address, telephone number, and hours when you can be reached; 2) Date of birth; 3) Military history, including dates, schools, experience, grade or rank, and MOS (primary and others); 4) Civilian training and experience; 5) FCC license if any; 6) CW speed; 7) Typing speed; 8) Marital status and dependents.

If your letter indicates that you have the required qualifications, a formal interview will be arranged in the near future. Address letters to Mr. Carlton H. Broadnax, P. O. Box 8254, Southwest Station, Washington 24, D. C.

Slim Wilson W4WQT
Route 3, Box 39
Madison, Alabama

Do Hams Have Fun?

IT took me a full hour to convince the neighbor that the lines on his TV set were not caused by my ham station. His main argument had been that he had no trouble until I moved into his neighborhood and now he had a lot of interference. I proved to him that his trouble was in his UHF converter and that actually he was causing me a little TVI himself. He finally asked the inevitable question you get from all who view a ham station for the first time, "How far can you reach with that radio?" I quickly let him see a few of my choice DX QSL's, knowing full well what his next question would be. "What did it cost to set up all that fancy radio gear?" I told him that the radio cost about as much as his new set of "walking polo clubs," that I had built the transmitter and it cost about as much as he had spent that year for "green fees and 19th hole refreshments." I had learned long ago to never quote actual cost to a non-ham, just compare the cost with his hobby.

The neighbor finally got interested enough to ask, "What do you talk about when you hook up with another ham, can you really have fun with a hobby like this?" I decided that since he had already, by this time, killed half a pint of my favorite "sour mash" I would spin him a few tales of some actual "fun" I had experienced with ham radio. These tales are all true, only the names have been changed to protect . . . myself.

Tale No. One: **The Rum Runner.**

I used to talk to a lot of Hams that operated stations on ships. They are called maritime mobiles and back in the old days they were only allowed to operate on 10 meters. One in particular got to be one of my best buddies. I had been aboard his ship, seen his station and even met the captain of the ship. Old Hotch was a fine fellow and we had talked to each other from all over the world. I usually knew his ship's schedule a full month ahead of time. One afternoon I heard Hotch calling, "CQ, USA, CQ, USA." I quickly called him and he came right back to me. It seems that he was docked at a port in a small South American country and was being paid a visit by the local government radio inspector. Hotch carefully explained that he was having difficulty explaining the "extra" radio station that he had in the ship's radio-room, that the government inspector had an interpreter with him and that he wanted me to come back and tell them just who I was, where I was located and that we were, indeed, nothing but ham radio operators. I could just picture poor old Hotch sweating and the government inspector looking over his shoulder waiting for my reply. Did I comply with Hotch's request? Why certainly not, this would have spoiled my fun. I went back to him and said, "Old boy, your signals are pretty weak (it were 40 over S-9) but I think you were asking me if I had found any new Rum customers. Yes, I have . . . please try to smuggle 9 cases of Rum out this trip instead of 6 cases like you did on the last trip down there. How do you copy—Over." A full minute went by and then my ex-buddy came back with a single statement—"Consider your throat cut." I found out later that it took both the ship captain and old Hotch quite a long time to explain.

My neighbor, by this time, had nearly finished my bottle of sour mash and had seemed to enjoy the tale I had spun. I held up the nearly empty bottle and said, "Now who would ever think that the golden contents of this bottle could actually become a part of a radio?" I then proceeded with . . .

Tale No. Two: **The Most Unique Radio.**

Every Spring and all through the Summer the hams meet at various towns and cities for re-unions or conventions. We call them ham-fests. The various radio manufacturers have displays of their newest radio gear and there are always "Door Prizes" given to a few lucky hams. Sometimes there are contests. One such ham-fest used to always have a contest for the most "unique home made radio." The requirements were that it had to be a simple Crystal radio, it had to actually work and it had to be unique. I entered this contest one year with a complete radio built in my earphones It was a powerful little set and worked real well. The judges awarded me second prize, a coil of acid core solder. I thought I should have gotten first prize but one of the judges explained it this way, "Well, we knew the other fellow." I made up my mind that come next year I would have a radio so unique that it would have to win first prize. Nearly 6 months went by before the idea came to me of just how I would build my contest radio—and I got busy.

I found a half pint plastic bottle, complete with bottle cap and decided to use it for a coil form. I first painted a vertical dial on the bottle with my XYL's red finger nail polish and then wound the outside of the "coil form" with some number 20 wire. I put a small fixed mica capacitor across the coil, a value that made the coil and capacitor combination tune to the middle of the broadcast band. I next mounted a 1N34 diode to the coil, another small coil with one end as antenna and one as the ground wire and then hooked a pair of earphones up to it. It actually worked, it wasn't very selective . . . in fact I could hear nearly all of the broadcast band at the same time, but it worked. I was proud of the little radio but still did not believe it was unique enough to win a prize. I decided that it would have to be tunable. What better way to tune a radio than to vary the inductance of the coil, I thought? I got to looking for some "Hi-Q Core Material" to put inside the plastic bottle—something that I could slide in and out to use as a "tuner." I could think of nothing with a Higher "Q" than a certain Tennessee Sour Mash bourbon . . . referred to in better circles as "B L J D." This was one ham experiment that I knew I would enjoy. I quickly filled the "coil" with BLJD, put on my ear phones and began to slowly "sip the core material." As the core level got lower and lower, the radio signals got stronger and stronger. By the time I got it "tuned" half way up the band the signals really began to come in. I will always swear that just as I took the last "tuning sip" that I heard a ZL calling "CQ 6 meters." I handed my "unique radio" to the ham-fest judges (complete with a full coil of Hi-Q core material) and explained how to "tune it." I knew I was a sure winner as soon as I noted the judges stooping down behind the judges' stand to "tune" my receiver. A certain radio magazine Editor attended that ham-fest and I noticed that he stooped a couple of times with the judges. This might explain why he nearly tripped twice while giving his little talk from the judges' stand later that day. After the contest I received my "unique radio" completely tuned and the first prize . . . a roll of rosin core solder. I reached up on the shelf and handed my most unique radio to my visiting neighbor, who by this time was ready to tune anything. He was nearly convinced, by this time, that hams do have a lot of fun. I proceded with . . .

Tale No. Three: **The Cat Operation.**

While chatting one evening on 75 meters a fellow ham broke in with a sad story about his little girl's pet cat. We could even hear the cat in the background every once in awhile. It sure seemed to be in pain. It seems, he said, that the cat had gotten its tail caught in the back door and it was almost cut off. He was trying to decide if he should cut it the rest of the way off or try to put a splint on it. We had suggestions to make but we knew that unless the poor cat got some attention pretty soon his crys of pain would drive us crazy. Finally one of the boys could stand it no longer, he called up a local pet doctor and phone patched him on the frequency. My friend with the cat carefully explained the cat's trouble and the Doc spent about 15 minutes carefully telling him how to amputate the cat's tail. My friend was not satisfied, however. He had another fellow to call another Doctor and this one, via the phone patch, carefully explained how to put a splint on a cat's tail. Now, I ask you neighbor, where else can one obtain the expert advice from the leading cat doctors in New York and Chicago in a matter of minutes after such a bad accident to a cat? What I didn't tell my neighbor and reveal to you for the first time . . . yes, it was a fictitious cat . . . I happen to know that the only pet my friend has is an old lazy hound dog. To hear the careful explanations from the doctors and the questions put to them by my friend was one of the most enjoyable hours I have ever spent with my hobby.

Tale No. Four: **The Trial**

Operating a Ham Station is a good way to spend a winter evening. I remember one time we had a culprit on 75 meters that was always giving us all a hard time. One Saturday evening we decided we were tired of his actions and decided to have a complete trial "on the air." We appointed a Judge (who also acted as a net control station), a complete panel of jurors, the defending lawyer and the prosecuting attorney. There were also many witnesses. The trial lasted all night. It took nearly three hours of discussion for the jury to reach a verdict. The culprit was found guilty and the Judge sentenced him to six weeks on two meters.

WANTED

Tubes, Diodes, Transistors, any quantity, all types; also Military, Commercial Lab-Grade Test Equipment, Components, PRC, GRD Equipment, Aircraft Equipment by Collins. TOP PRICES. Write details, Bob Sanett, W6REX, V & H Radio & Electronics, 2053 Venice Blvd., Los Angeles 6, California.

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Yes, sir, a lot of funny things happen to hams. I had a pretty hard time a few years back trying to explain to my XYL why a certain YL short wave listener kept sending me sweet, perfumed, powder sprinkled letters. My XYL just couldn't understand why the YL "fell in love" with my radio voice. By this time my neighbor had forgotten all about his TVI and really seemed to be interested in ham radio. He looked up on the shelf as he put my "unique radio" back—less core material and noted a little aluminum box with an ac cord coming out one end. He said, "What is this little gadget?" It was my little fuse tester and I proceeded with

Tale No. Five: **The Little Gem Fuse Tester.**

Sometimes a little fun can backfire. One year, just before ham fest time, I was sitting around tuning my "unique radio" and came upon the idea of building a little fuse tester. I knew that I would start out to the ham fest, which was located over 300 miles away, and probably spend a couple of nights with old buddies of mine. I wanted to have some fun while at each place. I took the small aluminum box and mounted a little fuse holder on its top, a heavy ON-OFF switch on one end under a neon bulb holder. I brought out an ac cord out the opposite end after hooking it up "properly" in the little box. The Little Gem Fuse Tester was complete and, after the application of proper lettering on the outside, looked quite professional. The most important thing came next . . . the writing of a simple "Operation Manual." The instructions read something like this:

CAUTION

This tester is designed to test the one to ten ampere fuses contained in your ham gear. Do not try to test any fuse larger than 10 amperes. Follow instructions very carefully."

1. Turn radio on and set dial to 3980 kc. Set receiver gain control for comfortable listening level.
2. Remove top of fuse holder and insert fuse to be tested. Carefully replace fuse holder top.
3. Place ON-OFF switch in the OFF position.
4. Plug the ac line into the nearest ac receptacle. NOTE: This test is best conducted on your operating desk. The Test Lamp should light when the ac line is plugged in.
5. Turn the ON-OFF switch to the ON position. The test lamp should go out.
6. Replace Fuse.

In making up these instructions I was very careful to fill an entire page with them. I then had an out if some "smart boy" wanted to know what indication he should get for a good or bad fuse. I would merely state that I had lost page two of the instructions but the action of his receiver tuned to 3980 kc would let him know if the fuse was good or bad.

My first victim was an old ex-buddy of mine, Crumpy. Crumpy had an ideal ham shack in a beautiful Pine paneled Den. He had the complete KW Collins SSB rig with a fancy clock and beam position indicator. Crumpy served us all a delightful portion of Hi-Q core material and settled down at his operating desk to try out my little Tester. He spent a little time telling us about his fancy clock that had never been off by more than two seconds, all the while carefully reading the tester instructions. Rather than take a fuse from some piece of his gear he said he would try one of his spares first. We assured him this would be a good idea. Crumpy carefully tuned his receiver in on 3980 kc. set the gain control and proceeded to "test" the fuse. I shall never forget what happened when he turned the switch to the ON position. All the lights went out, the room was suddenly completely quite because the radio had also gone dead. The clock stopped too, of course and for a minute or two there was a general scrambling noise from Crumpy and then a flash light was turned on. Crumpy opened up the box of spare fuses and was about to put another in the tester when he caught on. Instruction 6 had said replace fuse —but it didn't say which fuse. You see, the fuse holder on the tester was a dummy, hooked to absolutely nothing while the switch was hooked directly across the ac line when placed on the ON position. My ex-buddy, Crumpy, soon found another service fuse and placed it in the fuse box down in the basement while we began to think of ways to get out without getting shot.

My next victim was old Joseph. How was I to know that he had his Ham Shack wired through a 50 AMP circuit breaker. He went through the same ordeal as Crumpy but when he placed the switch on the Little Gem Fuse Tester to the ON position there was a small explosion inside the little box and my little tester went up in smoke. So, dear neighbor, the little box you hold contains a little charred mess of switch and wire. I've never had the heart to rebuild it.

My neighbor, by this time, was convinced that we hams do have a lot of fun. He next asked. "I hear that you hams are a great help during times of distress. Did you ever help any one with your hobby"? I thought to myself, "I have helped this jerk, he has drank up all my Sour Mash." I quickly replied, however, "Oh yes, I have done my share I guess." I showed him the '55 Hurricane Hazel and '57 Kentucky Train Wreck Public Service Awards I had hanging on the wall. I next told him that I felt the most help I had ever been to anyone was back in '49 when I helped in . . . *Tale No. Six*: **The Movement to Keep Grandy Windy.**

Grandy, an old ex-buddy of mine, was perhaps the windiest Texan ever to operate on ten meters. He broadcast his braggings to every W1, W2, W6 and W7 that he could hook

up with. He lived in a little Texas town about 20 miles from my old home QTH. One day during a QSO with a certain W7 it was suggested that we should do our best to keep Grandy windy. It was decided that if he had plenty of beans in his daily diet it would help keep him windy. We agreed that we would ask everyone we talked to on ten meters to ship Grandy a can or two of beans. Thus, the Bean Campaign was born. The local radio club thought it to be a good idea and we all really got busy asking for beans for Grandy. We asked everyone we talked to if they would also spread the word. We W5's talked to the W1's, 2's, 6's and 7's. The W7's covered the middlewest, the east coast boys covered the South. Actually, as it turned out, quite a few DX stations got into the act too. One of the boys in New York suggested that it would also be a good idea to include a bar of soap with the beans. This idea caught on very rapidly. Grandy began to get beans and soap and I mean he began to get just lots of beans and soap. One fellow even sent him a full case of each. Grandy became extremely windy and in fact he got right down irrational at times, these times being every time someone asked him about beans or soap. He steadfastly refused to open a single can of beans or unwrap a single bar of soap. I decided to take my life in my own hands and pay him a visit. I got to his home just as a large truck from the post office pulled into his driveway. The postman unloaded about 25 or 30 packages. I asked the Postman if he made many deliveries to this address. He said, "Oh yes, I have made a trip nearly every day for several weeks now. A local ham told me that this fellow was on a bean diet and was trying out various brands from all over the world. I don't know what the soap is for." Since Grandy was not speaking to me, I had his XYL to sneak me in the back door. I have been in some pretty big Supermarkets in my day but I have never seen as many cans of beans or as much soap. Grandy had built two large shelves from floor to ceiling in one room. He had carefully unpacked each package and had a complete record of who sent what. I beat a hasty retreat before he got his shot gun loaded and gave a full report at the next ham club meeting.

A few weeks later I received a telegram from my W7 friend which read something like this: "Stop Bean Campaign. Think It is Illegal." I quickly grabbed the message and headed down town to the local FCC office. I put the question to the local FCC Inspector. Some few minutes later, after he recovered from a laughing fit (he knew Grandy), he explained that there was a rule some place about soliciting anything of value over the air. He advised that our Bean & Soap Campaign might be considered as being on the fringe of "soliciting something of value over the air." I agreed that we would do all we could to stop the campaign but that I felt sure it would have to just die a natural death. It finally tapered off but it took several weeks. Grandy donated a large truck load of beans and soap to an orphan home. I am sure it was a windy place for several months . . . but very clean. Today Grandy is perhaps the windiest fellow in the state of Texas. Yes, ham radio can be most helpful and a lot of fun.

My neighbor mumbled something about going home. I helped him out the door after he promised me to do something about all the TVI he was causing with his UHF Converter. I then tuned around the 75 meter phone band to see what was going on. The usual stuff was heard. A gang of SSB operators cussing AM, a gang of AM operators gripping about SSB, QRM and a CW station telling off some joker for calling CQ on his net frequency. It was a typical evening and I wondered how many hams were really having no fun that evening. I fired up my old sideband rig, set up my chess board and grunted a couple of times into the mike. Soon the frequency was filled with such remarks as, "I move my old black Mule to King three . . . I move my little pawn on Rook four to your Mule (Ham for Knight) three and capture your old Lady (Queen). About this time some joker disguised his voice to sound like my opponents and had me to move into a wrong play. All heck broke loose. Luckily, we had a Judge on the frequency following the game and he soon got our chess game back on the right road. We threatened to "have a trial and try" the joker next Saturday night if he messed us up again. We really knew, though, that he would try it again and all agreed that playing chess on a clear channel wouldn't be near as much fun anyhow.

I finally threw the big switch and decided to call it an evening. Just before I left the shack I took a long look around. There was the Little Gem Fuse Tester and the Unique Receiver . . . less core material . . . on the shelf. A little clear plastic "pill bottle" containing a small red ape with a bandage on its rear set on the speaker. A little tag was attached that read, "A Texan complete with Saddle Sores." On the wall hung a large poster received in the mail one day. It advertised a glorious Cosmo-Color movie entitled "Intimate Strangers," starring Jayne Mansfield and . . . myself. I'll never know who sent these little momentos but you can bet it was a ham. Just before going to sleep that night I wondered just how many hams devote their full hobby time to trying to "pass a law" our ham radio into some regimented mess of clear channels or just worry themselves to sleep every evening over the QRM. I decided to remain an "omphaloskepsis" (look that one up in your dictionary) and remain one of the many who still have a good time with our hobby—ham radio.

. . . W4WQT

R. B. Kuehn WφHKF
1212 Bellows St.
St. Paul 18, Minn.

Receiver Anthology

1961

Collins 75S-3 .....620.00
Hallicrafters S118 .... 99.95
Hallicrafters S119 .... 49.95
Hallicrafters S120 .... 69.95
National NC-190 .....199.50
National NC-303 .....449.00

1960

Drake 2B 279.95
Gonset G-63 .....239.50
Heath GC-1 Mohican.. 99.95
Hallicrafters SX-62A .395.00
Hallicrafters SX-115 .595.00
Hallicrafters SX-140 .109.95
Lafayette HE-30 ..... 99.50
National NC-270 .....249.95
National NC-400 .....895.00
RME 6900 .....349.00

1959

Drake 2A 269.95
Gonset G-33 ..... 89.95
Gonset G-43 .....159.50
Hallicrafters S-107 ... 89.95
Hallicrafters S-108 ...129.50
Hallicrafters SX-110 .169.50
Hallicrafters SX-111 .249.50
Hallicrafters SX-101A.399.50
Hammarlund HQ-180 .429.00
Lafayette KT-200 .... 64.50

1958

Collins 75S-1 .....495.00
Hammarlund HQ-160 .379.00
Hammarlund HQ-170 .359.00
Hammarlund HQ-145 .269.00
Heath RX-1 .....274.95
National NC-303 .....449.00
RME 4350A 249.00

1958

Hallicrafters S-38E .. 54.95
Hammarlund HQ-110 .229.00
National NC-66 .....129.95
National NC-188 .....159.95
National NC-109 .....199.95
RME 4350 .....229.50

1956

Hallicrafters S-101 ...395.00
Hallicrafters S-102 ... 59.95
Hallicrafters S-106 ... 59.95
Hammarlund HQ-100 .169.00
Hammarlund HQ-140X.249.50
Hammarlund HQ-150 .295.00
Hammarlund
PRO-310 .....595.00
Heath AR-3 ..... 27.95
RME-4300 .....194.00

1955

Collins 75A-4 .....595.00
GPR-90 .....395.00
Hallicrafters SX-99 ..149.50
Hallicrafters SX-100 .295.00
Hallicrafters SX-380 . 49.95
National NC-300 .....349.95

1954

Hallicrafters S-85 ....119.95
Hallicrafters SX-96 ..249.95
National NC-98 .....149.95

1953

Hallicrafters S-38C .. 49.50
Hallicrafters S-53A .. 89.95
Hallicrafters SX-88 ..499.95
Hammarlund HQ-140X.264.50
Heath AR-2 ..... 25.50
National NC-88 .....119.95

1952

Collins 75A-3 .....550.00
Hallicrafters SX-73 ..975.00
Hammarlund
SP600JX 985.00
National HRO 50-1 ..383.50
National HRO-60 ....483.50
National NC-183-D ...369.50

1951

Collins 75A-2 .....420.00
Hallicrafters S-76 ....169.50
National SW54 ..... 49.95

1950

Hallicrafters S-40B .. 89.95
Hallicrafters S-77 ... 99.95
National NC-125 .....149.50

1949

Collins 51-J 375.00
Hallicrafters S-52 .... 99.50
Hallicrafters SX-71 ..179.50
Hallicrafters S-72 .... 79.95
National HRO-50 ....349.00
RME VHF 2-11 .....146.00

1948

Hallicrafters S-51 ....149.50
Hallicrafters S-53 .... 79.50
Hallicrafters SX-62 ..269.50
National HFS 125.00
National NC-33 ..... 69.95
National NC-108 ..... 99.50

1947

Collins 75-A 530.00
Collins 75-A1 .....375.00
Hallicrafters SX-16 ..125.00
Hallicrafters S40-A .. 99.50
National HRO-7 .....311.36
National NC-46 .....107.40
National NC-173 .....179.50
National NC-183 .....269.00
National NC-200 .....159.50
RME HF 10-20 ..... 77.00
RME 84 ..... 98.70

1946

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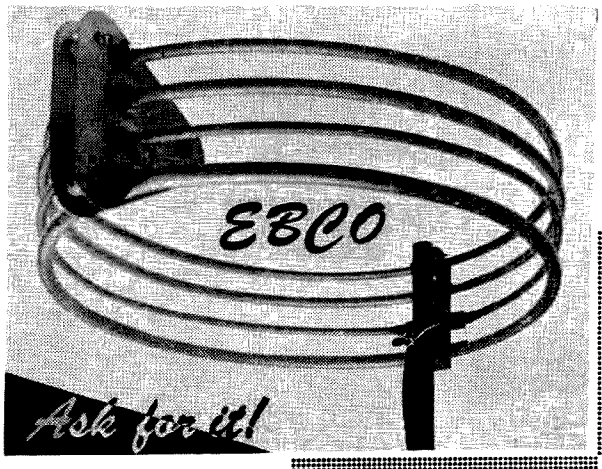
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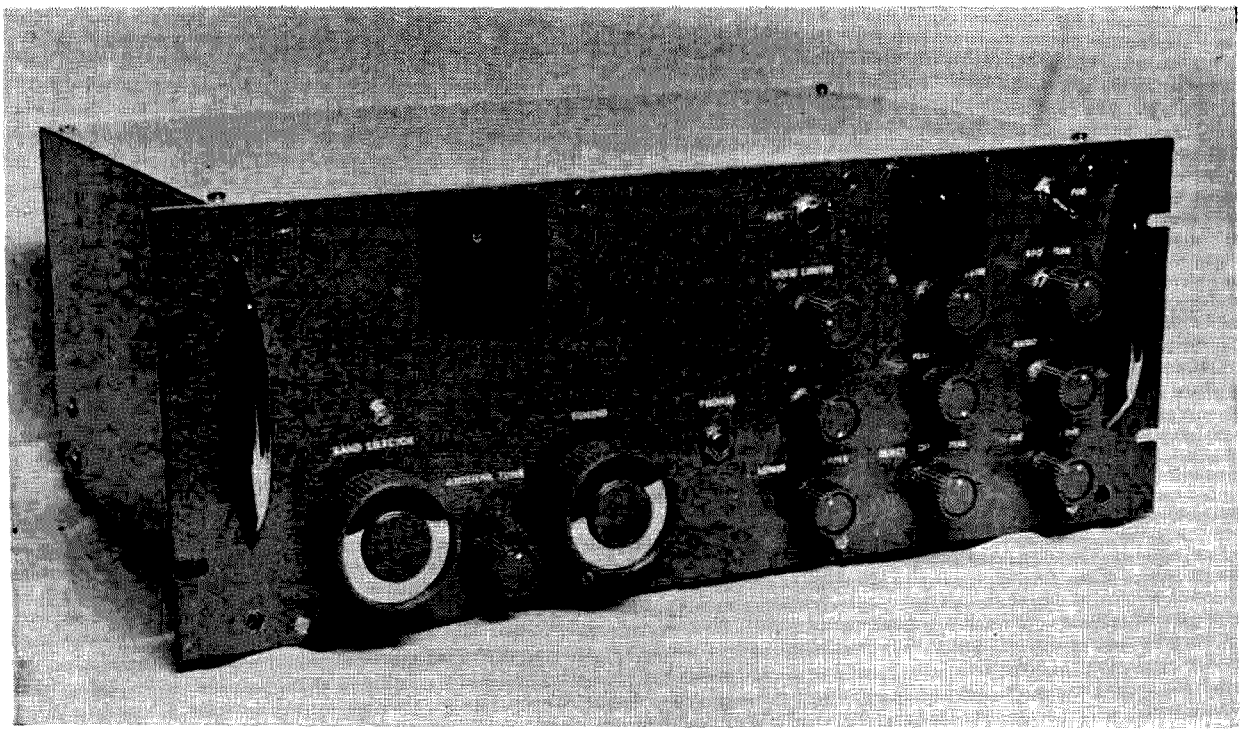
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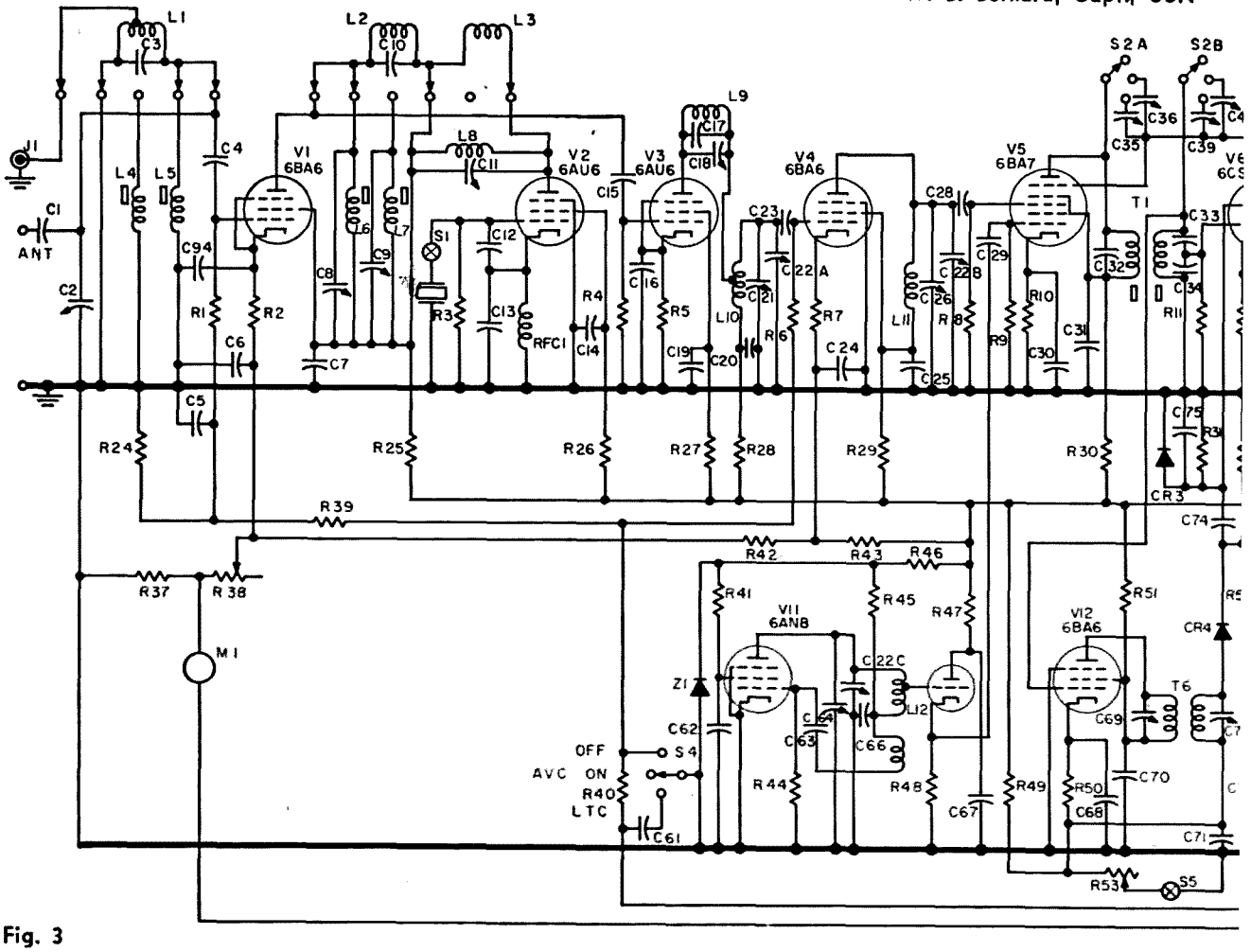


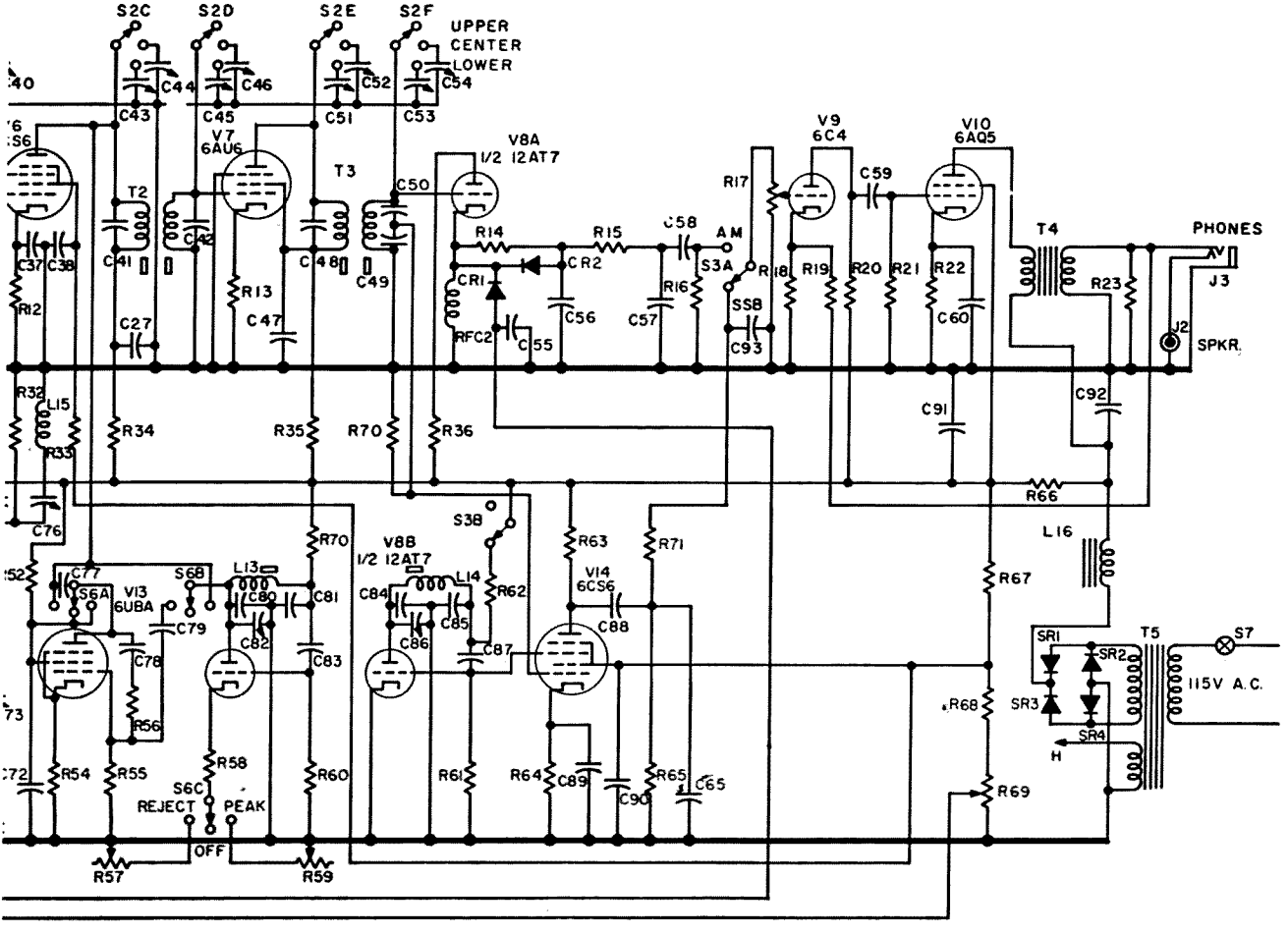
Fig. 3

THE need for a new receiver and the price asked for commercially built models which would meet the requirements of operation on the amateur bands today leaves the amateur with the choice of mortgaging the homestead or engaging in a do-it-yourself project. The writer decided on the do-it-yourself project. The experienced builder should not be intimidated by any apparent complexity of the finished receiver. The entire project was constructed with only hand tools and a ½ inch drill press. No doubt, most of the holes drilled with the press could have been done with a hand drill.

Before the construction project comes the design project. It was necessary to decide on the general features required in the receiver. The first requirement was the coverage of all amateur bands from 3.5 to 29.7 mc, with sufficient stability to receive SSB on any of the bands. About the only way to accomplish this is by using a crystal first oscillator and a variable *if* system. Other features desired were: A Lamb noise silencer, selection of upper and lower side band without retuning, a quick attack-slow release AVC system, a Q-multiplier, and a product detector. All of these features were designed and built into the 85 B. 14.

The resulting receiver, including the power supply is built behind a seven inch rack panel, and it extends eleven inches behind the panel. The completed receiver is shown in Fig. 1. Fig. 2 is the block diagram of the receiver. The receiver covers the desired frequency range in 8 bands of 500 kc each. Each of the bands is beat down to a variable first *if* of 2500 to 3000 kc by a crystal controlled injection signal higher in frequency than the received signal. The output of the first mixer (V3) is fed to the first *if* amplifier (V4) and then to the second mixer (V5). The tuned circuits in the first *if* system and the second oscillator are tuned by a three gang variable capacitor of the type used in FM tuners. This capacitor, in turn, is mechanically coupled to permeability tuned coils which tune the *rf* amplifier and first mixer.

The output of the second mixer is fed into the second *if* amplifier system which consists of two stages. The first stage in this system (V6, the second *if* amplifier) is a 6CS6 controlled amplifier, the third grid of which is controlled by the output of the noise limiter system which consists of the 6BA6 noise *if* amplifier (V12) and a crystal detector. Also, connected to the second *if* amplifier plate is the Q-multiplier which uses a 6U8A tube (V13). The second stage in the system (V7, the third *if* amplifier) is a 6AU6 which is used mainly for isolation of the second and third *if* trans-



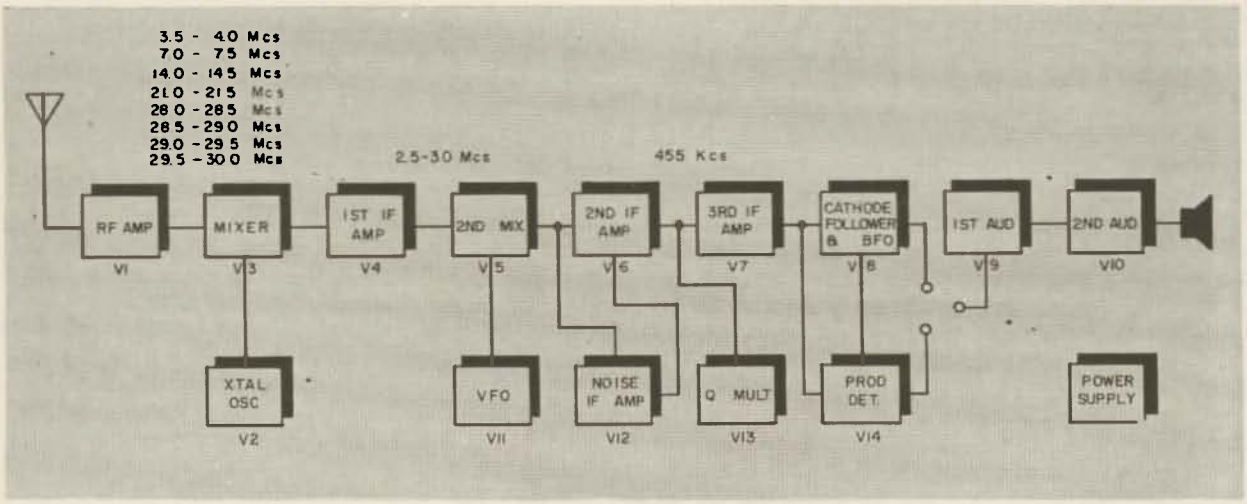


Fig. 2

formers in the system. Additional capacity may be switched across the *if* transformer windings to move the *if* system response, thus permitting the selection of either the upper or lower side band.

The output of the second *if* system is fed into a cathode follower (V8A) which drives the AM and AVC detectors, and into the first grid of the 6CS6 (V14) product detector. The detectors are followed by a two stage audio amplifier consisting of a 6C4 (V9) and a 6AQ5 (V10). Plate and heater power for the receiver are furnished by a Triad R-73 B transformer followed by a silicon bridge rectifier and a choke input filter system. The output of the plate supply is approximately 120 volts. Operating the receiver at a low plate voltage and the elimination of the rectifier tube greatly reduces the heat generated inside the receiver.

To proceed with the detailed description of the circuits, we turn to Fig. 3. We have two antenna input terminals. The low impedance terminal taps into the first tuned circuit and the high impedance terminal connects directly to the top of the first tuned circuit through a small capacitor. C2 is the antenna trimmer, which also furnishes the minimum circuit capacity on the higher frequency bands. C4 passes the rf signal to the grid of V1 and blocks the AVC voltage, furnished through R1, from being shunted to ground through the input tuned circuit.

The plate of V1 is coupled to the grid of V3 by C15 and the interstage circuit is tuned in a manner similar to the input circuit. The plate circuit of V2, the crystal oscillator, is coupled to the interstage circuit to inject the beating signal into the grid of the mixer circuit. On the lower frequency bands the coupling is capacitive, and on the higher frequency bands the coupling is inductive.



L5, L6 wound on Millen 69046 coil form with a length of ⅜" polystyrene tubing inserted in end.



L4, L7 wound on Millen 69046 coil form. Winding distributed as shown.

Since there are no variable capacitors, controllable from the front panel, connected across the interstage and oscillator circuits, it is necessary to install trimmers to compensate for changes in tube capacity and for ease of initial alignment. C8, 9 and 11 are the trimmers for these purposes.

It will be noted that there are two permeability tuned circuits in the grid circuit of the rf amplifier and two in the interstage circuit. Although it is theoretically possible to use one permeability tuned coil to cover all eight of the 500 kc bands desired, because of the stray capacity of the coils designed for use on the lower frequencies, it is not possible to use them at as much as four times the lowest frequency. It is possible to use the coils designed for 3.5 to 4.0 mc on 7.0 to 7.5 mc, but we must have another set of coils to cover the frequencies above 14 mc.

The permeability tuned coils must be shunted with capacity on the lowest frequency band on which they are used, and with inductance and capacity on the higher frequency bands. The accomplishment of all the necessary switching calls for a relatively complex switching device, so a Standard Coil TV turret tuner system was adopted as the heart of the receiver front end. The tuner chassis and the coil strips are completely stripped, except for the contact strips, and the tuner chassis is bolted to the inside of a 5 x 9½ x 1½ inch chassis which holds the tubes, permeability tuned coils and oscillator crystals. The turret and its associated strips switch into the circuit the desired permeability tuned coil and the necessary shunt capacity and/or inductance. Fig. 4 shows the wiring of the strips for the eight bands. There was not sufficient room to include the oscillator crystals into the turret assembly so a switch wafer was mounted on the front of the turret chassis to switch in the desired oscillator

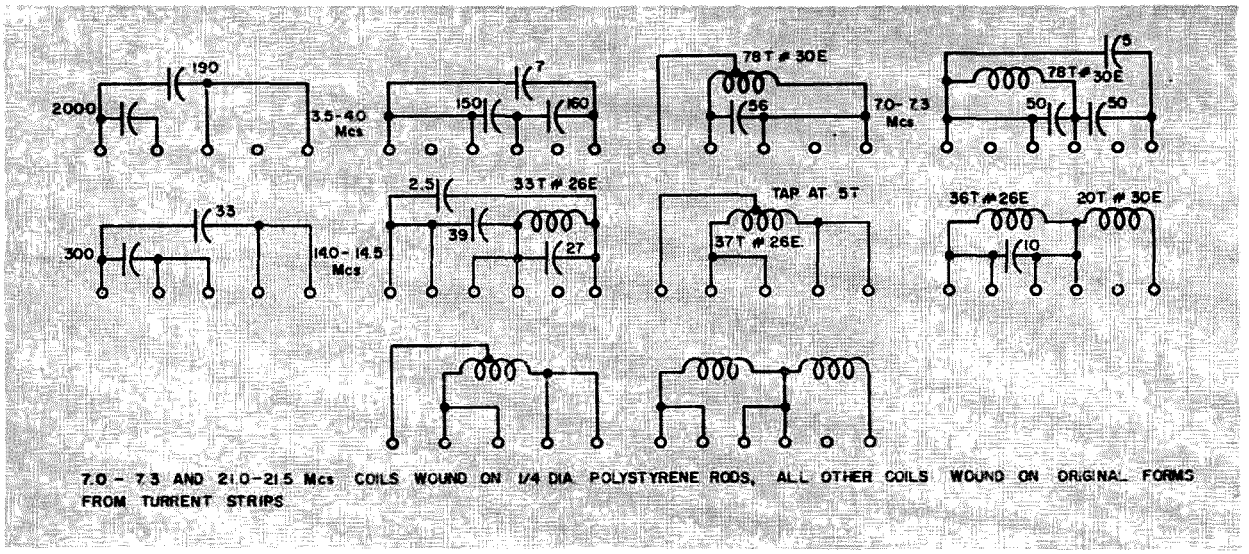


Fig. 4

crystal when the turret is rotated. The turret shaft is flatted to fit the rotor of the switch wafer. Figs. 5 and 6 show the front end chassis details.

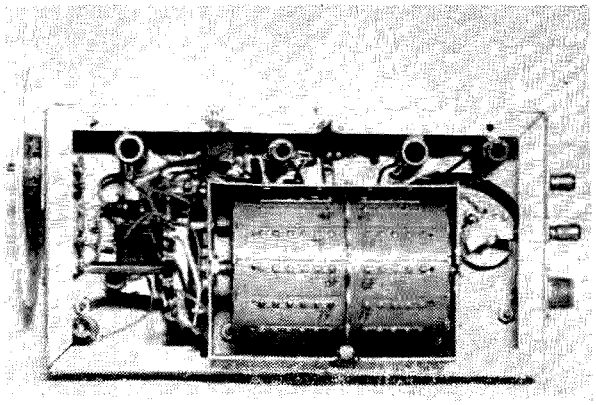
The output signal from the mixer is passed through a parallel resonant 6500 kc trap (C17, 18 and L9) which eliminates, or reduces to a negligible level, a few birdies found on the 3.5 to 4.0 mc band. Following the trap, the signal is fed into the input circuit V4, the first *if* amplifier. Here the rf signal is passed to the grid by C23 which blocks the dc from flowing between the tuned circuit and the AVC system. Another tuned circuit forms the interstage coupling between V4 and V5, the second mixer. The beating signal to beat the first *if* signal down to 455 kc is furnished by V11 which is connected as a pentode grid tickler oscillator and a triode cathode follower. The plate and screen voltages of the oscillator are regulated by Z1, a 62 volt zener diode.

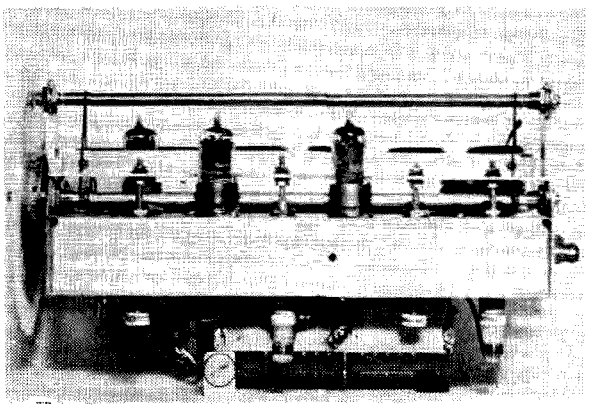
The circuits associated with the first *if* amplifier, second mixer and second oscillator are tuned by C22, a three gang FM tuning capacitor. Because the capacity variation of this capacitor is so small, it was necessary to take some precautions to insure satisfactory oscillator stability. The oscillator coil is wound on a ceramic form and a cathode follower is used to isolate the oscillator from the load.

C22 is driven by a cable drive arrangement. The same cable is used to drive the dial which is mounted on the windlass shaft which operates the elevator for the four slug tuned coils (L4, 5, 6 and 7) used in the front end of the receiver.

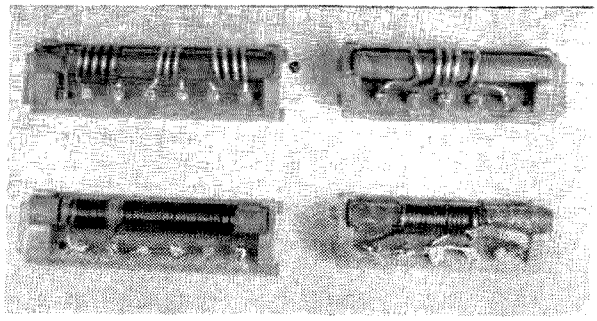
The output of the second mixer is fed into T1. The T1, T2 and T3 are *if* cathode traps from MN-26 radio compass receivers. The inductors in these traps are enclosed in ferrite pots with adjustable cores and the Q at 455 kc is in the vicinity of 200. The 5000 mmfd capacitors originally connected across the inductors are removed and the capacitors shown in the diagram substituted. S2 selects the proper additional capacitors to move the bandpass of the *if* system from the upper side band to either the center band pass or the lower side band.

The full voltage across the secondary of T1 is applied to the grid of V12, the noise *if* amplifier. One-tenth of the secondary voltage is applied to the grid of V6, the controlled *if* amplifier. This makes available sufficient voltage to properly operate the noise silencer without danger of overloading the remainder of the *if*





Figs. 5 and 6



Details of turret tuner strips.

system.

The output of V12 feeds the primary of T6 and the voltage developed across the secondary of T6 is rectified by the diode CR4. The output of the diode rectifier is filtered by a series resonant filter consisting of C76 and L15. The filtered noise pulses are ac coupled to grid 3 of V6 to cut off the plate current of V6 when a noise pulse is present in the *if* system. CR3 is a dc restorer which prevents grid 3 of V6 from being driven positive with respect to ground. A 6CS6 was selected for the controlled *if* amplifier since the plate current in this type tube may be cut off with a much lower value of negative voltage than that which would be necessary to cut off the plate current of a pentagrid mixer tube such as a 6BE6 or a 6BA7. R53 varies the amplification of V12 and also sets the initial bias on CR4.

The output of V6 is fed into T2. The Q-multiplier V13, is also connected to the primary of T2. The triode section of V13 is connected in the regenerative circuit which may be switched to reduce the losses in T2 when S6 is placed in the PEAK position or to increase the inverse feedback in the pentode section when S6 is set to the REJECT position. C77 compensates for the change in capacity which occurs across the primary of T2 when S6 is set to different positions.

The secondary of T2 feeds the grid of V7. V7 is operated at very low gain by placing a large unbypassed resistor in the cathode circuit. The output of V7 feeds into the primary of T3. The secondary of T3 feeds the cathode follower, V8A, which drives the AM and AVC detectors and it feeds, at a level of one-tenth the maximum secondary voltage, grid 1 of the product detector V14. The grid 3 of V14 is connected in parallel with the grid of the BFO, V8B.

The audio outputs of both detectors are filtered in pi section RC filters and connected to S3 which selects the desired audio output and applies the plate voltage to the BFO for SSB and CW reception.

The entire AVC voltage is applied to V4 and half the AVC voltage is applied to V1. S4 may be thrown to short the AVC voltage to ground, or to connect a large capacitor from the AVC bus to ground to produce a long release time constant. In the center position of S4, the AVC circuit is left in normal operation.

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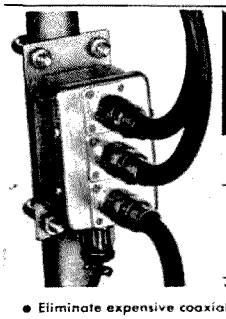
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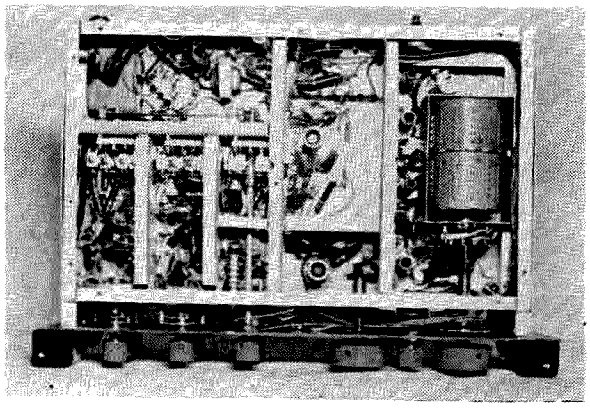
The audio amplifier is a conventional two stage system with about 6 db of inverse feedback applied to lower the output impedance of the system and to prevent extreme voltages from being developed across the primary of T4 in case the load is removed from the secondary of T4. A closed circuit jack in the secondary of T4 allows the use of headphones, and it cuts off the audio signal to the speaker jack when a plug is inserted in the jack. R23 is a resistor load used to maintain the stability of the amplifier under all conditions.

The power transformer, T5, feeds into a silicon bridge rectifier and then into the choke input filter system consisting of L16 and C92. Further filtering for all circuits, except the plate of V10, is done by R66 and C91. R67 and R68 act as a bleeder system and furnishes 30 volts to screen grids of V6 and V14.

The entire receiver is built on a 10 x 17 x 2 inch chassis, which is mounted an inch behind the 7 x 19 inch rack panel. Special end brackets were made to simplify the remainder of the receiver enclosure. Under-chassis partitions were placed between the various stages of the receiver to minimize birdies and instabilities. Because of the low *if* gain in the receiver, the *if* interstage partitions may well be superfluous, however it is easier to build them in in the first place than to add them after the receiver is finished. See Figs. 7, 8, 9 and 10.

After the construction of the receiver is completed, we may begin the process of alignment and calibration. The rf gain control is set at minimum gain S3 set at AM, noise limiter turned off, Q multiplier set at reject and R57 set at maximum value. S2 is set for the upper sideband and the *if* transformers are aligned to 457 kc. The Q multiplier is then turned off and C77 is adjusted for maximu *if* response.

S2 is then set at the center position and trimmers C36, 40, 44, 46, 52 and 54 are adjusted to set the *if* bandpass to 455 kc. With the signal generator set to produce an unmodulated signal at 455 kcs, the S3 is set to SSB, L14 is adjusted to give a zero beat between the BFO and the signal generator with the BFO tuning capacitor set at midscale. S3 is then reset to AM.



S2 is set for the lower side band and trimmers C35, 39, 43, 45, 51 and 53 are adjusted for maximum response at 453 kcs.

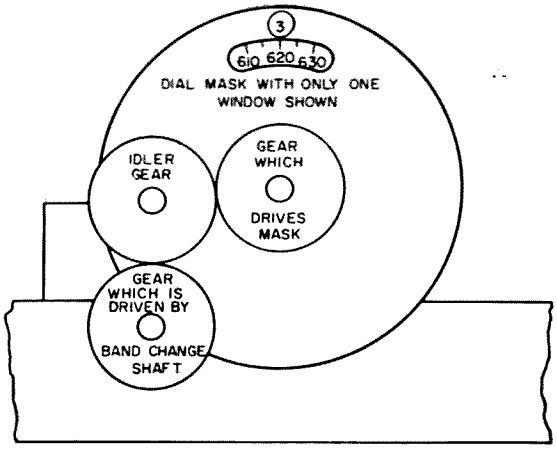
With S6 set at PEAK, S3 set on AM, C82 set at mid range, and R59 set so V13 is oscillating, L13 is adjusted to give a zero beat between the BFO and V13.

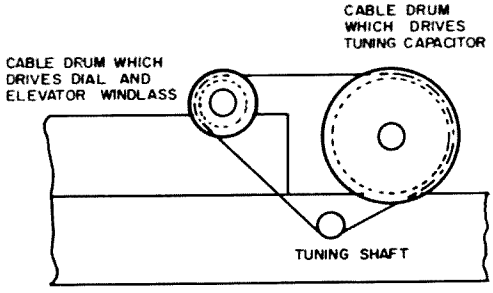
Next the BFO and the Q multiplier are turned off and a 455 kc modulated signal is applied to the grid of V5 and adjusted for an audio output well above the noise level. The noise limiter system is then turned on and the gain of V12 increased until an increase in the output signal is observed. The primary and secondary of T6 are then adjusted to give maximum output. C76 is then adjusted to give a minimum output.

We are now ready to align the first *if* system. To do this we must connect a signal generator covering the frequency range of 2500 to 3000 kc to the grid of V3. By adjusting the trimmer capacitors at the high frequency end of the band and the inductors at the low frequency end of the band, it should be possible to get the desired coverage after going through the adjustment process a few times. Once all the adjustments are considered to be satisfactory and the tracking of the three circuits is proper, the dial may be calibrated. This should be done with an accurate frequency meter or frequency standard. When the dial is being lettered, it must be remembered that the high frequency end of the first *if* band is the low end of the input frequency band. Thus a first *if* of 3000 kc corresponds to an input frequency of 3500 kc and a first *if* of 2500 kc corresponds to an input frequency of 4000 kc. By having the first figure, or figures, of the desired band on the dial mask, it is necessary to have only two scales on the dial. One from 0 to 500 kc and one from 500 kc to 1000 kc.

The alignment of the front end of the receiver becomes a little more tedious, but it is not difficult. The crystals and turret strips are inserted for one band at a time, starting with the lowest frequency. Thus the 6500 kc crystal and the 80 meter strips are placed in the receiver and a signal generator covering the band is connected to the antenna. With the generator and receiver dials set at 4000 kc, the antenna trimmer and trimmers C9 and 11 are adjusted for maximum signal. The generator and receiver dials are then set for 3500 kc and the antenna trimmer and C9 adjusted for maximum response. If the trimmers required an increase in capacity, the coil slugs should be lowered further into the coil forms. If they require a decrease in capacity, the slugs should be withdrawn slightly from the forms. It may take a few adjustments before satisfactory tracking is achieved. Once the 80 meter band is finished, we may move to the 40 meter band.

The 5000 kc crystal and the 40 meter strips





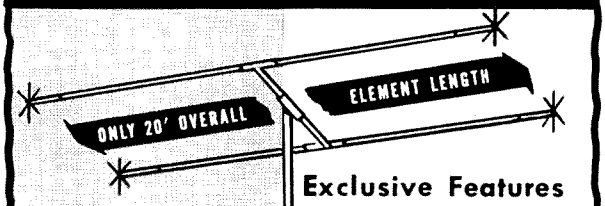
are inserted in the receiver and the signal generator and the receiver dial are set for 7200 kc. The antenna and mixer coils are then adjusted for maximum response by pushing and stretching. The generator and receiver should then be tuned to 7000 kc and the antenna trimmer varied for maximum response. If it must be tuned to a higher capacity, the antenna coil should be pushed together slightly. If the trimmer must be turned to a lower capacity, the antenna coil should be stretched slightly. The generator and receiver should then be returned to 7200 kc and the results of the operation checked. After a few adjustments, the coils should be properly adjusted and polystyrene coil dope should be applied to maintain the adjustment.

Next the 8500 kc crystal and the 20 meter strips are installed in the receiver. The alignment on 20 is similar to the alignment on 80 except that the antenna trimmer, C8 and the slugs in L5 and L6 are the adjustments for tracking. The shunt coil for the oscillator must also be adjusted for maximum response of the receiver.

For the 15 meter band and the 10 meter band there are three shunt coils for each band which must be adjusted. In general, if the antenna trimmer is set for the 20 meter band it should be possible to align the higher frequency bands in the center of each band since the tracking becomes less critical as the frequency is raised. For instance, at 29 mc if the tuned circuit Q were as high as 100, the mixer grid circuit could be mistuned almost 150 kc before the loss in gain reached 3db. When we align in the center of the 500 kc band we would not be likely to get anything like this much mistracking when we tune only

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*Patents pending

Exclusive Features of Model B-4010 40 plus 10 meters

- New end loading for maximum radiation efficiency*. *No center loading employed.*
- Element length only 20'; boom 10'.
- About 22 lbs. in weight.
- Feed line 50 ohm coax.
- SWR . . . 1.5:1.
- Rated for full 1000 W-A.M.

Model B-4010 Amateur Net — $79.50

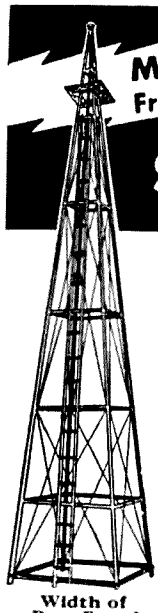
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Order direct from factory . . . or from your favorite distributor

MORE SIGNALS PER DOLLAR From Money Invested in an Antenna

Self Supporting STEEL TOWERS For Rotary Beams, FM, TV



You can erect this tower yourself. Just dig four holes, set anchor posts in place, bolt the pieces together. 5½ ft. ladder sections make it easy to work higher as tower goes up. It's a lot of fun to build your own tower — and saves you money, too!

ATTRACTIVE — NO GUY WIRES!

- 4-Post Construction for Greater Strength!
- Galvanized Steel — Will Last a Lifetime
- SAFE — Ladder to Top Platform
- COMPLETE — Ready to Assemble
- Withstands Heaviest Winds

Width of Base Equal to 1/5 Height

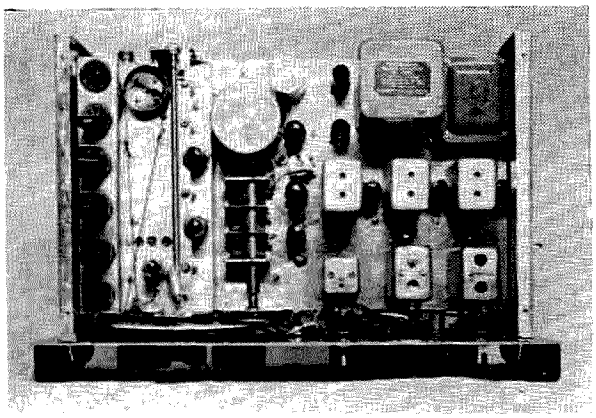
SMALL DOWN PMT.—EASY TERMS

Vesto Towers are available in a wide range of sizes to meet requirements of amateurs and commercial users alike. Note the low prices for these quality lifetime towers: 22'-$ 159, 28'-$ 194, 33'-$ 229, 39'-$ 276, 44'-$ 313, 50'-$ 362, 55'-$ 408, 61'-$ 463, 77'-$ 724, 100'-$1132.

Towers are shipped to your home knocked down, FOB Kansas City, Mo. 4th class freight. Prices subject to change . . . so order now! Send check or money order . . . or write for free information.

WRITE TODAY FOR COMPLETE FREE INFORMATION AND PHOTOGRAPHS

VESTO CO., Inc.
20th and Clay
North Kansas City, Mo



250 kc each side of center.

Naturally, after having built the receiver, there are some suggestions that I would make to any one wishing to build one like it. The first is one that would result in a little more ease of construction. If I had it to do over again, I would leave 1½ or 2 inches between the front panel and the front of the chassis. A larger tuning capacitor for the first *if* system would make it easier to achieve the desired second oscillator stability. If the constructor has or can obtain a tuning capacitor with a straight line frequency characteristic and a $\triangle C$ of about 150 mmfd per section, I would highly recommend it as a replacement for the capacitor specified. If the capacitor has four sections instead of three it would be possibe to use a double tuned circuit between the first mixer and the first *if* amplifier. This would possibly give enough rejection to make the 6500 kc trap unnecessary.

For the designer who wishes to use some means of producing *if* selectivity other than the double tuned transformers described, there is an abundance of reserve gain available in the second *if* system to make up for the loss in any filter system which may be desired.

The grid of V6 could be moved up toward the top of the secondary of T1 with a possible gain increase of 20 db. Another 15 of 20 db of gain could be realized by reducing the value of the cathode resistor of V7 and bypassing the resistor.

An additional three 500 kc bands within the frequency range of the receiver may be covered by the insertion of the proper crystals and coils in the front end. This can be increased to four additional bands if a twelve position rather than an eleven position switch is used for switching the crystals.

The total desired range may be covered in seven bands if the tuning range of the first *if* is increased to 2400 to 3000 kc. This would allow one extra band to be covered in addition to the amateur bands. This would require some modification of the slug tuned coils and would require three dial scales rather than two.

Whether or not the reader wishes to duplicate this receiver exactly, this article will have served its purpose if he is convinced that it is possible to home build a receiver which is modern in every respect and one which is equal to, or better, than the majority of receivers which may be bought commercially.

... Bernard

COIL DATA

L8, L9 20T #26E close wound on a ⅜" diameter form

L10 75T #30E close wound on a National XR-72 form tapped at 40 turns from bottom end

L11 75T #30E close wound on a National XR-72 form

L12 Plate winding is 60T #26E close wound and tapped 20 turns from cold end of coil. Grid winding is 10T #30E wound next to cold end of coil. Windings are wound on National XR-62 form with iron slug removed and a silver disk ¼" diameter substituted

L13 Miller #6300 ferrite antenna

L14 Permeability tuned coil .4 to .6 Mh.

L15 2.5 Mh RF choke

L16 10 H 100 Ma filter choke

Details of Turret Tuner Staips

28.0-28.5 Mcs	30T #22E tapped at 6T	30T #22E	14T #26E
28.5-29.0 Mcs	28T #22E tapped at 6T	28T #22E	14T #26E
29.0-29.5 Mcs	26T #22E tapped at 5T	26T #22E	13T #26E
29.5-30.0 Mcs	25T #22E tapped at 5T	25T #22E	13T #26E

PARTS LIST

C1	100 mmfd GP ceramic
C2	100 mmfd air variable
C3, 10	See coil data
C4	220 mmfd GP ceramic
C5, 20, 55	.01 mfd GP ceramic
C6, 7, 14, 16, 19, 24, 25, 27, 30, 31, 37, 38, 47, 58, 59, 62, 67, 68, 70, 71, 72, 74, 88, 89, 90, 94	.02 mfd GP ceramic
C8, 9, 11, 18, 21, 26, 76, 77	5-50 mmfd ceramic trimmer
C12	22 mmfd mica
C13, 23, 28, 29, 83	220 mmfd mica
C15, 56, 57, 65, 78, 79, 93	220 mmfd GP ceramic
C17	150 mmfd mica
C22	3 gang FM tuning capacitor, Miller 1461
C32, 33, 41, 42, 48, 49	270 mmfd silver mica
C34, 50	2700 mmfd silver mica
C35, 36, 39, 40, 43, 44, 45, 46, 51, 52, 53, 54	1-12 mmfd mica trimmers
C60	10 mfd 25 V electrolytic
C61	2 mfd 200 V paper
C63, 87	100 mmfd mica
C64	50 mmfd air trimmer
C66	1200 mmfd silver mica
C69, 73	part of T6
C75	50 mmfd GP ceramic
C80	900 mmfd silver mica
C81	2500 mmfd silver mica
C82	50 mmfd air variable
C84	330 mmfd silver mica
C85	1200 mmfd silver mica

C86	35 mmfd air variable
C91	40 mfd 150 volt electrolytic
C92	80 mfd 150 volt electrolytic

All resistors ½ watt fixed carbon unless otherwise specified

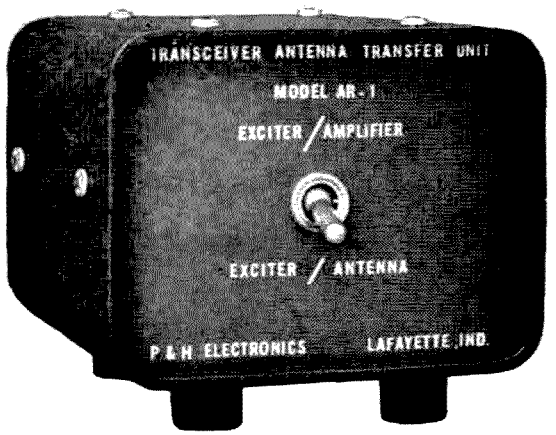
R 1, 11	270K
R 2, 7, 51	68
R 3, 32, 62	100K
R 4, 52, 55, 56	1M
R 5	4.7K
R 6, 8, 21, 24, 39, 71	470K
R 9, 48	22K
R10	150
R12, 64	390
R13, 26, 54	10K
R14	33K
R15	27K
R16, 65	2M
R17	500K potentiometer
R18	1.5K
R19	3.3K
R20, 27, 44, 61, 63, 71	47K
R22	560
R23, 37	22
R25, 28, 29, 30, 31, 33, 34, 35, 36, 41, 47, 50	1K
R38	20K potentiometer
R49	68K
R43	39K
R45	2.7K
R46	10K 1 watt
R49	82K
R53	20K potentiometer with switch
R57, 59	15K potentiometer
R58	6.8K
R60	560K
R66	56 2 watts
R67	6.8K 2 watts
R68	4.7K 1 watt
R69	50 potentiometer
RFC 1	2.5 Mh National R-100U
RFC 2	2.5 Mh Millen J-300-2500
S1	Centralab type UD wafer mounted on turret tuner
S2	3 double pole 3 position switches mechanically ganged
S3	DPDT rotary switch
S4	SPDT toggle switch with center off position
S5	SPST, part of R53
S6	3 pole 3 position rotary switch
S7	SPST toggle switch
T1, 2, 3,	Cathode traps from MN-26 radio compass receivers. Millen 61455 suggested as substitute
T4	Output transformer 7000 to 3.2 ohms
T5	Power transformer, Triad R-73-B
T6	455 Kcs output if transformer, Miller 512-C4
M1	500 uA 1½ inch meter
Z1	62 V Zener diode, 1 watt minimum
SR1, 2, 3, 4	Silicon rectifiers, minimum ratings 200 PIV, 125 Ma 400 PIV, 500 Ma should cost litt'e more and have a desirable safety factor

Crystals for first oscillator

Range Mcs	Injection Frequency Mcs	Crystal Frequency Mcs
3.5- 4.0	6.5	6.5
7.0- 7.5	10.0	5.0
14.0-14.5	17.0	8.5
21.0-21.5	24.0	8.0
28.0-28.5	31.0	7.750
28.5-29.0	31.5	7.875
29.0-29.5	32.0	8.0
29.5-30.0	32.5	8.125

NEW! from P&H

MODEL AR-1
TRANSCEIVER ANTENNA
TRANSFER UNIT



Here is the answer to the problem of using your transceiver as an exciter for any linear amplifier. The AR-1 transfers the antenna to the transceiver while receiving and provides the necessary switching to connect the exciter to the amplifier, and the amplifier to the antenna when transmitting. A front panel switch also permits the exciter to operate straight through to the antenna. The relay is shock-mounted and the case is insulated to reduce noise. Standard SO239 connectors are provided for low impedance coax lines.

LOW INSERTION LOSS: Transceiver output to amplifier input, less than 1.02:1 SWR, 3 to 30 Mc. Amplifier output to antenna, less than 1.12:1 SWR, 3 to 30 Mc.

The AR-1 requires 6.3VAC (6.3V jack on KWM-2) and normally open auxiliary contacts on the exciter relay. (ANT. RELAY jack on KWM-2). The AR-1 may also be used as a conventional antenna change-over relay. Size 3" X 4" X 4".

PRICE..... $32.50

P&H ELECTRONICS INC.
424 Columbia Lafayette, Ind.

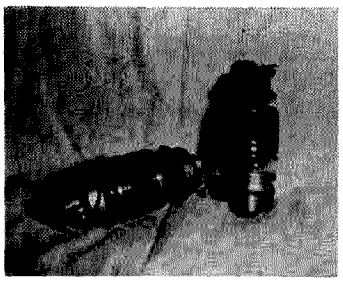
Heathkit Parts Sale

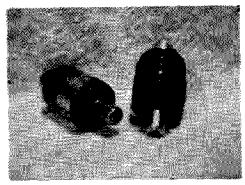
Close-out of new electronic parts originally purchased for use in kits now discontinued from the Heathkit line. Resistors, capacitors, transformers, tubes, and hardware every kit builder, ham, hobbyist, and industrial user will want. Prices just a fraction of the usual. Quantities limited.

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Benton Harbor 11, Michigan

Vacuum Capacitor Traps





Charles Spitz W4API
1420 South Randolph Street
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ONE questionable benefit of being a DX station is that you are on the receiving end of things and are able to develope some perspective about the efficacy of various antennas and transmitters. Several years of operating and thousands of QSO's have convinced me that the long wire multi-band trap antennas put out a signal second only to vertical antennas in weakness. They seem to work a lot better on 40 and 80 meters and are kind of handy to have around as a result.

One of the major problems in getting these antennas working and keeping them working is in making the traps. I tried the traps described by W9JYH in the December 1955 QST (page 24), only to have the wooden dowels go up in smoke when I fed a kilowatt to them. Next I tried ceramic rods, but eventually the sun and rain corroded the aluminum tubing capacitor and I was out of business again.

The original trap specifications call for 95 mmfd and 5 uh in order to have resonance in the 40 meter phone band. Ceramic capacitors are OK, but limit you in power. This was explained by W2CYK in his October 1956 QST article. The solution to this problem suddenly dawned when I spotted some Jennings vacuum 20,000 volt capacitors in a local surplus store. They were inexpensive and performed perfectly.

Details

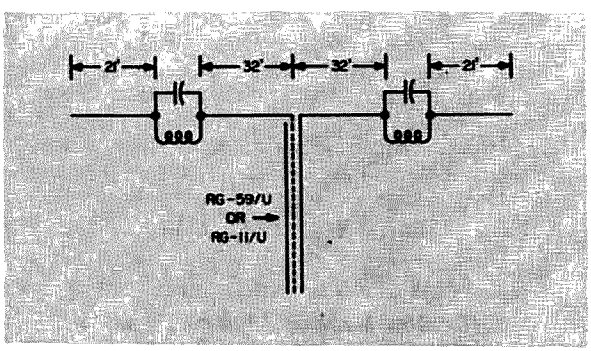
A 28 turn close-wound coil of number 14 enameled wire was wound over the center section of the capacitor glass (3½" dia.). This was tuned with a grid-dip meter to 7200 kc by pulling turns apart one at a time. The trap was then sprayed with General Cement No. 9123 high voltage Spra-Koat to hold the turns firmly in place. The capacitor was connected to the antenna with hose clamps, but a long insulator was used to take up the weight of the element which would be too much for the glass of the capacitor alone. A Birnbach 668 was used for this.

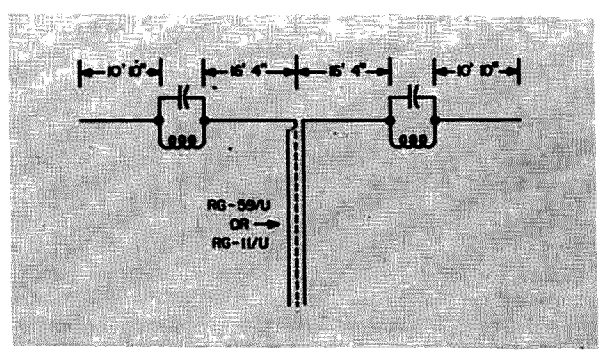
This same deal can be perpetrated on a 40/20 meter antenna such as is described on page 365 of the 1960 ARRL Handbook. In this case 25 mmfd capacitors and a 4.7 uh coil would be used. The dimensions in Fig. 2 are for the phone bands. With the smaller vacuum capacitors it is possible to make a good connection by carefully drilling the ferrule ends and inserting a bolt. Use care as the exhaust stem is in the ferrule on many of these and drilling should be done as far away from the capacitor end as possible.

The very common General Electric 50 mmfd capacitors are available surplus in good quantity and can be used, two in series, to provide the 25 mmfd. They may be connected in parallel for 40/80. In this case the simplest method is to use nine turns of B & W 3905-1 air inductor, as recommended by W2CTK.

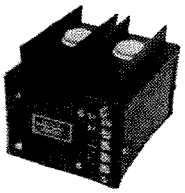
The use of vacuum capacitor eliminates the most critical source of deterioration in traps. Should you be experiencing poor performance from your trap antenna you might look to them for an answer. Due to mechanical problems, vacuum capacitors apply only to long wire antennas rather than to beams.

. . . W4API





SOLID, MAN



By now everyone has heard of solid-state power supplies—or have they? Here is a rugged little unit, extremely light weight, that is ideally rated for transmitters such as the Elmac, etc. Input 12 V, Output 500 V and 250 V at any combination of currents totalling 125 watts. We know of tests where they have held up for hours at much higher drains, so this is conservative. Just a palmful, 3" x 4" x 5" and 28 ozs., yet power to spare in running a medium-power transmitter and receiver. You might want to bug AIR ELECTRONICS, 7250 Hinds Ave., North Hollywood, Calif. for more details. At last count they were $49.50 each.

Filter

The November '61 issue of 73 had a very nice TV tuner receiver which seems to have headed quite a few readers toward the workbench. A lot of interest has been generated in the little filter shown as part of this circuit. This is made by Itek Electro-Products Company and you can get a catalog sheet, complete with considerable circuit data from them by dropping a line to Hugh Ware W1PYD, Itek, 75 Cambridge Parkway, Cambridge 42, Mass.

Letter

Dear Sir:

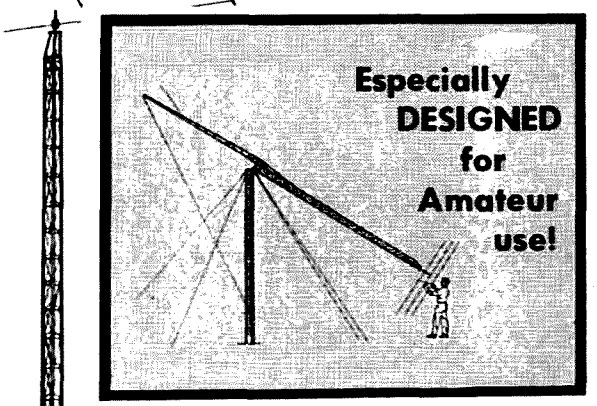
I hope some day to become a Ham and experiment in the 432 Mc. band with A5 (television) emission. This is an ambition easily achieved in your land of freedom with your unique development, the Technician's license. Here in Canada, things are different. I must obtain an Amateur Radio Operator's Certificate requiring 100% perfect morse code at 10 w.p.m.; purchase a HF transmitter receiver; erect an antenna and operate for a year to obtain sufficient QSL cards to qualify for an Advanced Amateur License which itself requires 15 w.p.m., 100% perfect code. This final license is endorsable for A5 emission.

There appear to be two types of Hams: the operating and the experimenting. You in the States have recognized the existence and importance of the experimenter; we in Canada force the experimenter to become an operator and make a considerable outlay in money and time in order to qualify for a license which allows him to experiment. This is unjust in my opinion.

At present, the Canadian Amateur Radio Operator's Certificate allows the amateur to transmit an unmodulated carrier, tone, AM voice, FM voice, facsimile, teletype, etc., but not television. I for one would like to see the privileges of this certificate increased to include television.

B. A. Robinson, P. Eng. VE9OX

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ROHN "fold-over" towers are ESPECIALLY made for amateur use. They are the most practical tower in design because they allow you to work ON THE GROUND for antenna maintenance and servicing. You'll quickly agree that this is a most wonderful feature for an amateur tower. In addition, these towers are made and designed for true, heavy duty use. They are structurally sturdy for use up to 70 feet and in enough sizes for *all* types and sizes of amateur antennae. This means that they can easily handle your requirements. They have unexcelled workmanship. They are hot-dipped galvanized after fabrication which means you have no problem of maintenance. They come as a complete package with all materials and accessories included. Add all these wonderful features together and you see why they're the most demanded tower today! Priced from $186.

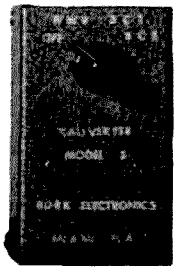
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*Patent—2,875,865

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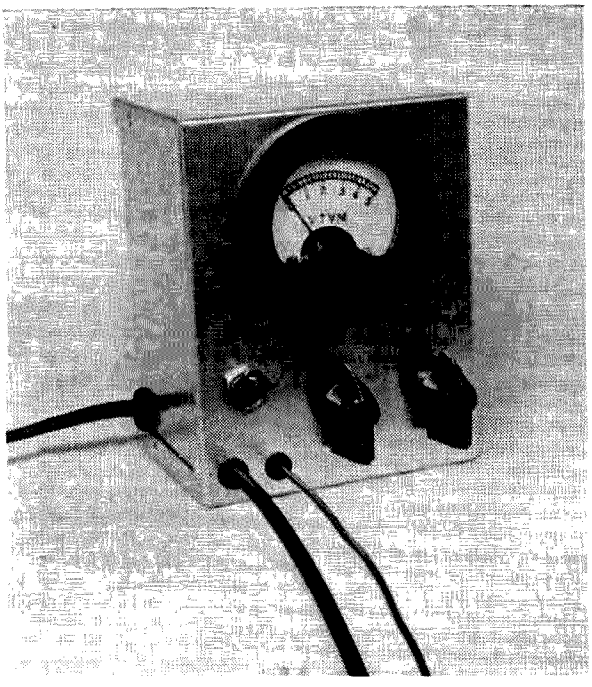
Model 5—WWV & L.F. Aircraft
Model 6—WWV & 7540 KC Mars
Model 7—Mars 7540 KC & L.F. Aircraft

Complete, less two pencell batteries. $14.95 plus .25 postage and handling.

Write to:

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Box 50-456 — Miami (Gratigny Br.) 50, Florida



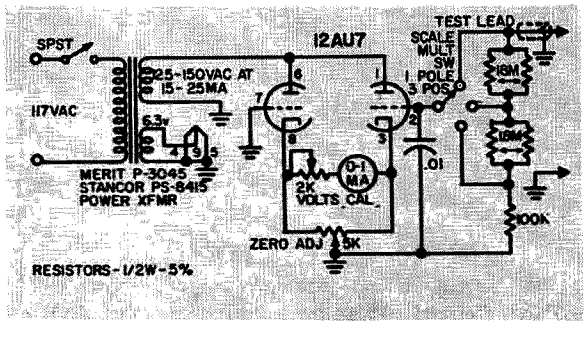
Budget VTVM

Ken Matsen W7INX
900 N.E. 87th Avenue
Portland 20, Oregon

IT certainly isn't necessary to extoll the usefulness of the vacuum-tube voltmeter, however, many hams and casual experimenters do without the aid of this instrument because they already have an ordinary volt-ohm meter, and feel they can't shell out the extra cash for a commercially built job, or even one in kit form. If you fall in this category, here is your chance to add a VTVM to your test equipment, economically.

Every effort has been made to reduce the circuit to its simplest form and still maintain good performance, accuracy and stability. This has been done, for the most part, by eliminating the frills and everything not absolutely connected with the voltmeter operation itself. Leaving all other possible functions, such as resistance and current readings, to the aforementioned volt-ohm meter.

The circuit is the familiar bridge, with each triode section of the 12AU7 forming one arm, and the "zero adjust" potentiometer forming the other two arms. Voltage from the transformer is applied to two corners of the bridge, the one formed by the connection of the two plates of the 12AU7, and the other by the center tap of the "zero adjust" potentiometer through ground. With no voltage on the 12AU7 grids the bridge is balanced by this control. A positive voltage to the grid of the 12AU7 (pin 2) will make the triode draw more current, which in turn causes the cathode voltage to rise. The milliammeter then reads the current flow between the two cathodes, which is proportionate to the voltage applied to the grid.



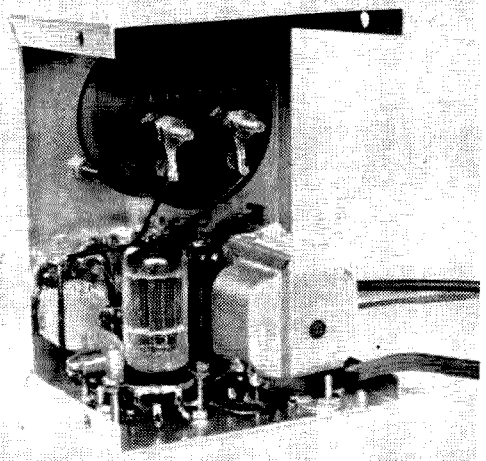
In building a unit such as this on a budget, considerable savings can be made with a reasonably well stocked junk box. When building my own meter the only purchases necessary were the power transformer and the minibox, so the actual cost was less than five dollars. The milliammeter was removed from a piece of Navy surplus and the rest scavenged from the proverbial junk box. However, even if all parts have to be purchased, the cost should still be less than half that of a VTVM in kit form. The costliest single item is the 0-1 milliammeter, but the more reasonably priced moving vane type of meter will keep the cost low, and it works very well in the circuit.

All components are housed in a 3 x 4 x 5 minibox, however the location of parts is not critical, so any convenient box can be used and this is left to the discretion of the builder. Controls on the front panel from left to right are, ac switch, scale multiplier switch, and "zero adjust" potentiometer. The "calibration" potentiometer is mounted on a bracket inside the case, and after once adjusted need not be touched for long periods of time. The "hot" test lead must be shielded cable. A two or three foot length of microphone cable, or even small co-ax is ideal for this purpose. The common lead is ordinary flexible test lead wire. No attempt was made to provide jacks for the leads because they need never be removed. This also eliminates any possible trouble due to loosening and subsequent poor contacts. The resistors

necessary to multiply the meter scale in the proper ratio, are not standard values, so in each case two standard resistors are paralleled to obtain the proper resistance values.

In calibrating the meter it is necessary to calibrate the low voltage scale only. The others will be automatically calibrated in multiples of ten and one hundred. A new scale must be made for the meter. To do this, cut a piece of heavy white paper to the size and shape of the original meter face. Draw an arc corresponding to the one on the meter and divide it into five equal parts. Subdivide these into five equal subdivisions. You will now have a basic five volt scale, which is multiplied to 50 volt and 500 volt scales. A known voltage source is needed for calibration, a couple of flashlight batteries in series will do nicely. Accurately measure the voltage with another meter. Zero the meter on the VTVM and put the leads across the known voltage. Adjust the "calibrate" control, which is mounted inside the case, until the meter reads the known voltage. The meter then should read correctly for all scales.

During the several months that the meter has been in operation here in the shack, it has held its zero adjust and calibration very well, and has worked most satisfactorily on all counts. . . . W7INX



EXCLUSIVE

Did you know Bob Graham deals only in Amateur Radio Equipment? Did you know he has two stores handling only equipment such as Collins, National, Hallicrafters, Hammarlund, Gonset, Johnson, Central Electronics, Clegg, Globe, etc.? Did you know he services all types of ham gear as well as buys, trades, swaps, rents, and installs equipment? Did you know he has a large selection of reconditioned and guaranteed used gear? You didn't! Well now you do

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KTV
HY-TRACK TOWERS

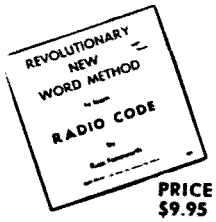
The biggest improvement in crank-ups yet — you crank up the antenna and not the tower. It takes a minimum of space, is fast to erect, and you can never fall off! Makes it a snap to change beams or make adjustments whenever you please. You can even crank the beam up to the best height for current propagation conditions. See the photos on page 15 of the March '62 73 for a better idea of what this is all about. Send for literature and prices:

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GENERALIZE YOURSELF!

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The EASY WAY



No Books To Read—No Visual Gimmicks To Distract You. Just listen and learn

Based on modern psychological techniques — This course will take you beyond 13 w.p.m. In

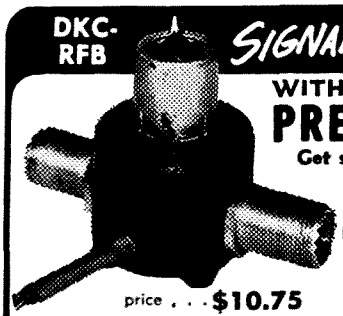
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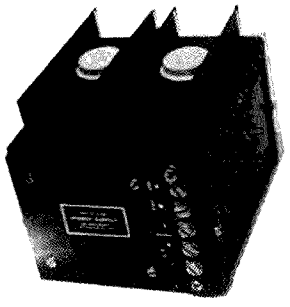
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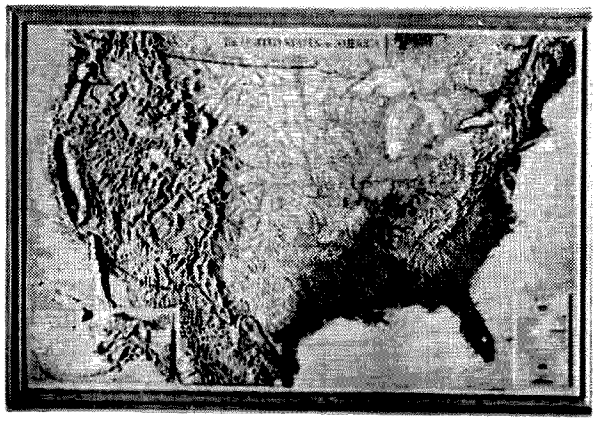
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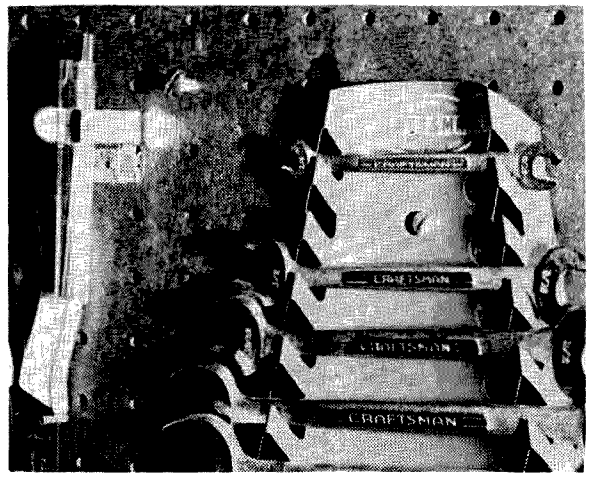
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Pegboard Mounting Aids

Many amateurs use peg-board for mounting tools and accessories and with the wide range of hangers available, its use goes a long way toward reducing clutter in the shack and shop. There are however, many items that do not lend themselves to mounting with commercial hangers. The photograph shows two techniques that are useful in mounting those "difficult" items.

Very small tools and accessories may be stored in plastic "pill boxes" or tubes. A standard, clip type tool holder may then be used to mount the tube. The photograph shows an assortment of Swiss needle files stored in this fashion.

Mounting special fixtures on pegboard is complicated by the fact that there is normally no access to the rear of the board. If the object to be mounted is not too heavy, standard machine screws may be used. The 12-24 size screw threads nicely into the perforations of the board and will hold a substantial weight. The photograph shows a commercial wrench set mounted using this technique. . . . W4WKM



Photograph by: Morgan S. Gasman, Jr.

Letter

Dear Wayne:

If you'd like to increase the DX capability of the 2.455 kmc receiver in the March 62 issue, try putting about 50 microamps forward bias on the 1N21B diode. This is standard practice in crystal-video receivers and greatly increases the sensitivity of the diode detector. Paul Barton's explanation of the modulation you receive on the police radar signal wasn't quite correct. To get the doppler modulation, the received signal has to be beat against the transmitted signal, which is not available in your car. The received signal does turn out to be amplitude modulated, but this is due to the ground reflected signal setting up an interference pattern with the direct signal. This causes a rapid flutter as you drive through the pattern, similar to what you get operating vhf mobile, but enough higher in frequency to be audible as a tone. In any case, the receiver should work. **Nathan Gold K1MIA**

more notes on

Silicon Rectifiers

John C. Wait K5IPY
Route 8
Fayetteville, Arkansas

REFERENCE is made to the two articles in 73 *Magazine* on silicon rectifiers. (Vol. I, No. 12, Sept. 1961, "Silicon Rectifiers" by Henry Cross, W1OOP, and Vol. III, No. 1, Feb. 1962, 'Silicon Rectifiers . . . Continued" by Charles Pierce, WA6QFD). The article by Cross states "For the simple way out, avoid: Choke Input Filters . . ." Both articles appear to deal with capacitor input filters and avoid the choke-input type.

Choke Input Filters have superior voltage-regulation compared to the capacitor input type. And, because of the high current peaks during the charging of the input capacitor, there is a reduction of the current-carrying capacity of the rectifiers when used with a capacitor input filter.

The Peak Inverse Voltage of the rectifiers (the peak voltage that the rectifier must withstand when the voltage is applied in the non-conducting direction) depends upon the circuit used. The p.i.v. can be 3.14 (π) times the dc output voltage for the case of a single-phase, full-wave, center-tap connection. (The p.i.v. of 3.14 happens when, say, the cathode is at a positive peak voltage +E and the peak voltage applied to the anode is —E, resulting in a p.i.v. of 2E. Since the dc voltage is $2E/\pi$, the ratio of the two is π which is equal to about 3.14.)

As An Example, if 600 p.i.v. silicon diodes are to be used to supply 1500 vdc using a single-phase, full-wave, center-taped circuit (which is the usual case), the p.i.v. is equal to (1500 x 3.14) which equals 4710 volts. The number of diodes used in each leg would be equal to (4710/600) which equals eight. One might use nine diodes in each leg as a factor of safety.

The Voltage Peaks (transient voltage) are not evenly distributed across the string of diodes and may exceed the voltage rating of the diodes. This can cause one diode at a time to be short-circuited and result in failure of the entire string. The use of 0.01 mfd capacitors connected across each diode will tend to keep the peak voltages equalized across the diodes. If there are many diodes in a string, a 0.001 mfd capacitor can be put across a group of about six diodes. Other means of protection against transient voltages would be the use of each rectifier with a p.i.v. rating higher than that which might occur (which would be more costly), or the use of nonlinear resistors to give protection against the voltage peaks (General Electric trade name Thyrite).

Overload protection for silicon rectifiers must be fast acting (about one-half cycle or less). This can be done by using special high-speed fuses (such as Bussman's Silver Strand). A more costly means of protection would be to use rectifiers of higher current rating.

While on the subject of choke-input circuits, we might consider the minimum value of inductance needed. This is the value of inductance needed to ensure a continuous flow of current under low-load conditions. The following example (in which transformer and rectifier resistances are neglected) will serve to illustrate a method of calculating the minimum inductance.

We have a single-phase, full-wave choke-input power supply operating from a 60-cycle source. The dc output voltage is 1500 volts, minimum load current is 100 ma., bleeder resister is 50,000 ohms, and the choke resistance is 80 ohms. The external load resistance at minimum load is

$$\frac{\text{E output}}{\text{I min. load}} = \frac{1500}{0.100} = 15{,}000 \text{ ohms.}$$

External load resistance paralleled with bleeder resistance is

$$\frac{15000 \times 50000}{15000 + 50000} = 11540 \text{ ohms.}$$

Total load resistance (choke resistance plus bleeder resistance paralleled with external load) is

$$R = 80 + 11540 = 11620 \text{ ohms.}$$

The minimum (critical) inductance is

$$L_c = R/A = 11540/1130 = 10 \text{ henrys.}$$

("A" is a constant, and is equal to 1130 for a 60-cycle source and a single-phase full-wave rectifier).

(Note: values have been rounded off.)

A value of inductance of about ten henrys or greater should be used, or the value of the bleeder resistor could be made less, and the problem recalculated. . . . K5IPY

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IV/5C-80	80M	18.95
*IV/5C-248	20,40,80 M	32.95
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* NOTE - 4 TRAPS EMPLOYED
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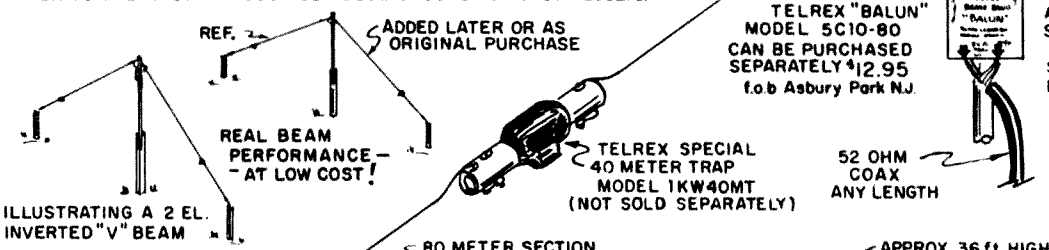
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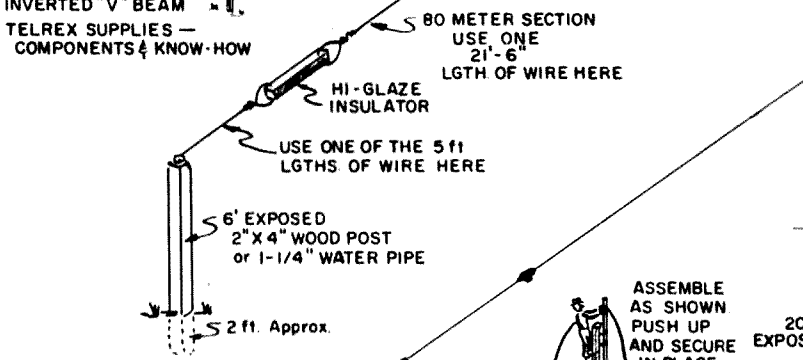
INSTALLATION SUGGESTIONS

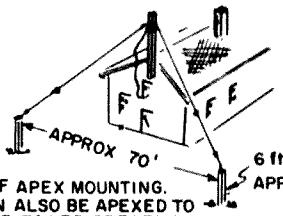
AS ILLUSTRATED YOU CAN MAKE UP A NEAT INEXPENSIVE SELF SUPPORTING ANTENNA STRUCTURE AS INDICATED OR ATTACH TO YOUR TOWER OR HOUSE STRUCTURE

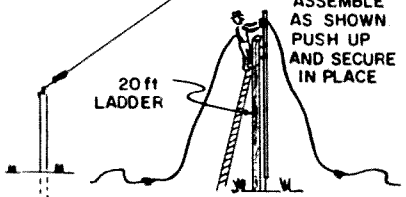
1 st ORDER OF PROCEEDURE, CUT THE COPPERWELD WIRE INTO 7 LENGTHS (2) PCS 34'-6" LONG (THE 40 METER SECTION) (2) PCS 21'-6" LONG (THE 80 M. SECT.), (2) 5' LONG AND (1) 4' LONG.

THEN ANCHOR THE "BALUN" AND TIE THE 40 METER SECTION APEX TO THE MAST AT ABOUT 36' ABOVE GROUND FOR BEST RESULTS.









NOTE —
DIMENSIONS GIVEN ARE APPROX. IT IS IMPOSSIBLE TO PROVIDE EXACT DIMENSIONS BECAUSE OF VARYING GROUND CONDUCTIVITY AND SURROUNDIND OBJECTS WHICH CAUSE THE ANTENNA TO LOOK LONGER OR SHORTER AT YOUR SITE.

YOU CAN BY CUT AND TRY, EFFECT EXACT RESONANCE TO YOUR FAVORITE SECTOR OF THE 40 M. BAND BY INCREASING OR DECREASING THE LGTHS. OF THE 40 M. ANTENNA SECTION, THEN PROCEED TO DO THE SAME WITH THE 80 M. SECTION.

UNLESS EQUIPPED WITH THE PROPER INSTRUMENTATION AND ABILITY, WE SUGGEST YOU PUT THE ANTENNA UP AS SUGGESTED
— SIT BACK AND HAVE FUN —

NOTE! TELREX INVERTED "V" DOUBLET KITS DO NOT REQUIRE GND RADIALS, INEXPENSIVE AND EASY TO INSTALL PROPERLY.— WILL OUTPERFORM ANY MULTI-BAND DOUBLET OR VERTICAL!

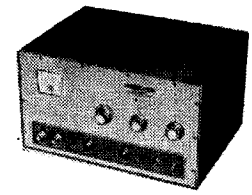
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73 Tests The Heathkit HA-10 Linear



Al Brogdon W4UWA/K3KMO
316 West Fairmount Avenue
State College, Pennsylvania

HEATH has come through again with a real deal—where else can you get a kilowatt for $230? The Heath HA-10 sells for $230 in kit form or (for the Citizens Band crowd) $330 wired and tested. The kit takes about ten hours to wire, so if you want to brag about the time you did a job for ten bucks an hour, buy the kit and wire it yourself. As with all Heathkits, you need no knowledge of radio or electronics—all you need is a reaonable ability in reading plain English, and a hot soldering iron for where it says (S).

The HA-10 circuit is the "tried and the true" 811A grounded grid circuit that has been described a great number of times in the various amateur radio publications. This particular kit uses four of the 811A's in parallel to run 1000 watts PEP on sideband, 1000 watts CW, 400 watts AM linear, or 500 watts with a controlled-carrier exciter. A neat little neutralizing circuit is used that makes use of a third winding on the filament choke for the necessary feedback.

The HA-10 has an untuned input circuit that matches the 50-75 ohm output of most exciters, and a bandswitching tank circuit for 80 through 10 meters that uses a pi-section to match 50-75 ohm loads. Any antenna outside this impedance range should be fed through an antenna tuner. The instruction manual recommends that "every effort be made to get the SWR of the antenna down to less than 2 to 1." Of course, this is no problem, since most modern hams think it is impossible to "get out" with an SWR higher than 1.5:1, and have their feedlines perfectly flat. Personally, I would rather "get out" well than have a pretty reading on a "vizwaar" meter, but some hams prefer the pretty reading. But I digress.

Condensed Specifications

Driving power required—50 to 75 watts, repending on frequency in use.
Maximum power input—1000 watts PEP SSB, 1000 watts CW, 400 watts AM (500 watts controlled carrier).
Input circuit—approximately 70 ohms, untuned.
Output circuit—Pi-network, 80 through 10 meters, 50 to 75 ohms.
Tube complement—four 811A, two 866A.
Power requirements—117 v ac, 50-60 cps, 1250 watts maximum.
Cabinet size—19½" wide x 11⅝" high x 16" deep.
Weight—90 pounds actual, 100 pounds shipping.

The HA-10's plate power supply is a husky full-wave rectifier with a pair of 866A's delivering nominal voltages of 1600 key-up and 1350 key-down. (A note of explanation is in order here. "Key-up" and "key-down" are archaic phrases that allude to ancient times when amateurs used telegraph keys for communications. These conditions are equivalent to "no load" and "full load" respectively.) The bias supply delivers a stiff 4.5 volts to the grids of the 811A's, with provision on the rear panel for connecting 45 to 150 volts of cut-off bias during receiving periods. A cooling fan is mounted directly behind the 811A compartment and comes on when the filaments are turned on to insure adequate cooling.

A single 1 ma meter is used for metering, being switched to read (full-scale) 200 ma grid current, 1000 ma plate current, 2000 volts plate voltage, and an arbitrary scale (0-1000) relative power output. The relative power output position is valuable for "on-the-nose" tuning, since maximum output does not always coincide with minimum plate current. (As a note of historical interest, it should be mentioned that the phrase "on-the-nose" is a tribute to one of our contemporaries in amateur radio, and a great operator—Mr. K. Nose, KH6IJ. Many such phases may be found in ham radio, such as the CW operators' favorite expressions of "FB" and "73," referring, of course, to the grand old man of telegraphy, Samuel F. B. Morse, and their favorite magazine, respectively.)

In addition to the panel meter, an adjustable oscilloscope take-off is provided on the rear apron of the chassis. The instruction manual gives full details on hook-up for monitoring of your signal on a scope, a worth-while feature for proper linear operation.

The rf section of the HA-10 is placed along the front half of the chassis, with the power supply components along the rear half. The rf section is provided with a full shield around it. This, plus the added shielding of the cabinet itself, does an excellent job of shielding which aids in TVI reduction. The packaging job on the HA-10 is very nice, with the whole linear weighing in at 90 pounds and taking up less than two cubic feet. Indeed, this is a far cry from the 75 meter phone kilowatts of ten years ago, which were built in seven-foot relay racks and required a dozen husky men to move

around.

The instruction manual gives full information on operation of the linear, including description of pads to be used if your exciter runs more than 100 watts output, or if the linear is to be used for extensive AM operation. The HA-10 is designed for use with the common 50 to 100 watt exciters, but may be run at reduced input with less than 50 watts. A statement appears in the manual saying that "the HA-10 should not be used to amplify AM signals in excess of 100 watts, as a worthwhile increase in power will not be realized." I admire Heath's honesty in making this statement, since there are many of our fellow amateurs today who do not realize that the S-unit scale is not linear, but requires a *four times* power boost to read one S unit higher. But nowadays, the kilowatt is a status symbol, and a lot of the fellows will run the HA-10 behind their Apaches, DX-100's and Viking II's with the only indication of the power increase being the increased electric bill each month. Speaking of electric power, the HA-10 manual mentions no less than three times that wiring to the outlet feeding the HA-10 115 vac input should be no smaller than #14. This advice should be heeded, since the Warrior draws over 10 amps under full load.

The front-panel controls include bandswitch, tuning, loading, meter switch, relative power sensitivity, filament switch and plate switch. Also on the front panel are the meter and the two king-size pilot lamps. Across the rear apron of the HA-10 are the following connections: rf input, rf output, ground lug, AC input, bias terminals, scope output, and scope amplitude adjustment.

W3JZF, now in Florida awaiting his new "four" call, was kind enough to allow his Warrior to be used in some efficiency measurements. Table 1 shows the results of this effort. The Warrior was driven by an HT-32A exciter, and the output was fed to a 50 ohm dummy load. The rf voltage was measured at the load with a Hewlett-Packard model 410B VTVM. Input was adjusted to 700 ma indicated plate current on all bands except 10 meters, where the HT-32A could only drive the Warrior to 660 ma plate current. As noted in the instruction manual, 30 ma of bleeder current is included in the current indicated on the plate meter, so this amount was discounted from the meter reading. The efficiency as shown in Table 1 is called "indicated efficiency," since part of the HT-32A output will appear in the Warrior output. It would have required far more time than was available for measurements, to measure the actual efficiency, so the figures are labeled apparent efficiency and the heck with it.

The apparent efficiency on all bands is 50% or better, so this is fair efficiency. There are some purists in the crowd who by now are screaming, "I can get 75% efficiency with a class C stage!" True, but let us mull this over a bit. Assume we have two one-KW amplifiers, one of which is 50% efficient, the other, 75%. So one puts out 500 watts, and the other, 750. So what? This is only 1½ db, or a quarter of an S unit. If you are so bad off that this quarter of an S unit will kill you—take up stamp collecting. Worrying about that last db is somewhat akin to the fellow who worked for months in finding compass directions from his location to any point in the world—within one half of one degree. Then he used these figures to aim his four element beam—you know, the one with a beamwidth of 15 degrees.

It should be pointed out to owners and prospective owners of the Warrior or any other linear amplifier that the FCC defines input power with grounded grid amplifiers to be the input to all stages supplying power to the antenna. This means that the input power with the combination used in the tests mentioned above, according to FCC definition, would be the sum of the input power to the HT-32A and that of the Warrior. And this sum should not exceed 1000 watts. The 1000 watts was exceeded during the efficiency tests, but this was into a dummy load, so it was OK. But be careful not to exceed the limit when you're on the air, else a friendly FCC representative might catch you at it some day.

All in all, the Warrior is a very attractive, lightweight (considering), and compact package that is well worth the asking price. In fact, if you will check catalog prices of comparable components, you will see that it would be difficult to copy the Warrior for $230. And an added feature as far as economy goes is that the 811A final tubes may be bought on the surplus market for as little as $3.65 each. This beats having to buy a $35 tube in case of a failure. . . . K3KMO

Frequency (kc)	Plate Current	Plate Voltage	Output* (rf volts)	Power Input	Power Output	Apparent Efficiency
3900	670	1350	165	905	545	60%
7250	670	1390	170	930	580	62%
14330	670	1460	162	980	525	54%
21300	670	1450	156	970	490	51%
28900	670	1420	158	895	500	56%

***Output measured across a 50 ohm dummy load.**

Complete Fire Insurance

Or How Not To Tune for Maximum Smoke

James Lee W6VAT
Box 45621
Los Angeles 45, California

IF you ever reversed the polarity of your power supply when hooking it to your latest vacuum tube creation, most likely nothing happened, in more ways than one! Oh, you may have "popped" an electrolytic or two, but vacuum tubes are notoriously lousy conductors when their plate and screen voltage polarities are reversed.

Not so transistors. If you catch it in time, no harm may be done, if not—well, back to the local radio store for more transistors. Once W6VAT mistook an NPN transistor for a PNP (just another way polarity can be reversed) in an rf amplifier. It worked beautifully just long enough for the tank circuit to be tuned to resonance. Suddenly, as the nice sine wave slowly faded from the scope screen, the light dawned—but too late.

So, what can be done about it? Take advantage of the very thing that the vacuum tube has in its favor—high conduction in one direction, and none (or very little) in the other. This assures GO/NO GO performance with no destructive results, only don't use vacuum tubes. Use a semi-conductor diode of the proper current rating for the job. One simple method is shown in Fig. 1.

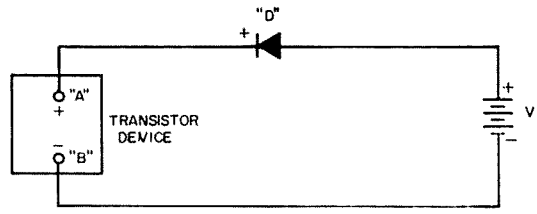
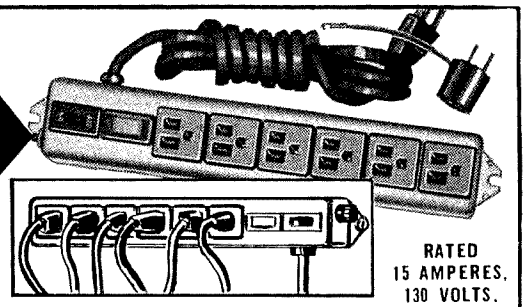


FIG 1

"A" is the positive terminal of the transistor device and "B" the negative. Hooking the cathode (or +) terminal of diode "D" to "A" will allow the current from battery "V" to flow normally as though "D" were a short circuit. A good diode will have less than a one volt forward drop at currents of several mils or more. If "V" is reversed, "D" will severely limit the flow of current, thus protecting the transistor device. What about the reverse voltage across "D"? First, the transistor device has some resistance which with "D", forms a voltage divider so that the voltage across "D" is lowed. Second, most transistor devices run on voltages (both plus and minus) of less than 100 volts total. Thus, any diode with a maximum reverse voltage rating of 100 volts or so, should work well. Always

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Model 24CB (Circuit Breaker Type) $10.50

(Fire from page 70)

remember to hook the diode to the circuit—not the battery. If the anode of "D" is hooked to the battery first and then the combination to the circuit, no protection is available, since the diode will always be forward biased. If you hook the diode up to the circuit wrong to begin with, you will have to make another mistake to cause trouble. That mistake is reversing the battery voltage. Generally, people don't make two consecutive mistakes—one is usually enough.

If you don't want to worry about whether the battery is hookel up properly or not, build up the circuit shown in Fig. 2 and keep it around. The circuit is simply a bridge circuit.

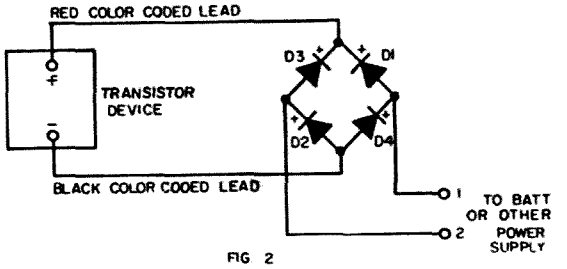


FIG. 2

Once connected properly to the transistor device, it does not matter how the battery is hooked to terminals 1 and 2. If 1 is positive, conduction is by way of diodes D_1, D_2 since D_3, D_4 will be back biased. If 2 is positive, then D_3, D_4 conduct. By color coding the leads, the job of connecting them is easier. Of course, you can *still* make a mistake, but devices can be made only "idiot resistant," not "idiot proof." Current considerations of the diodes and the circuits are the main things. For low voltage, lower power circuits, four 1N34's should be fine. Voltages up to 100 V and currents up to 300 ma could use four 1N91 germanium rectifiers in this circuit.

Cathodes are either marked with a band or the symbols "CATH" or "+". Remember, the arrow head points in the direction of POSITIVE current flow, and as such, toward the POSITIVE terminal of any device. The cathode of any rectifier is the terminal from which POSITIVE voltage is obtained. Either circuit in Fig. 1 and 2 will help keep your shack and workbench smoke free.

. . . W6VAT

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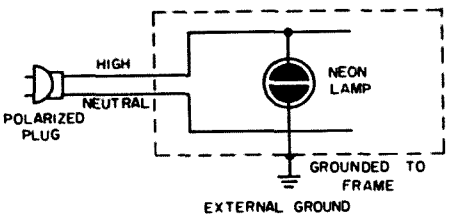
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The circuit shown here gives a POSITIVE indication of proper grounding, as well as correct polarization of the power plug. A neon lamp, mounted on the front panel, is connected between the frame of the apparatus and the HIGH side of the incoming line. The neon lamp will glow ONLY if the power plug is properly polarized and the chassis is connected to an external ground. . . . W2WYM

Radio Bookshop

Your hamshack is no better than your reference library (things are in bad shape, eh?), so get cracking at this list of recommended books. If you still have some money left over then look back over the last ad or two in past issues of 73.

We surveyed a number of top electronics schools and have it on good authority that these are the best up-to-date books on

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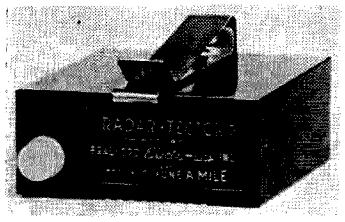
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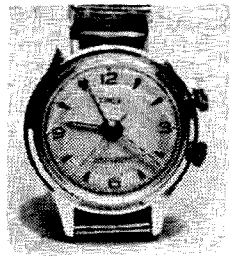


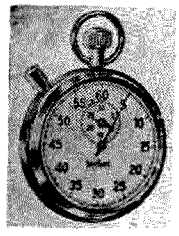
Radar!

Bradford Electronics makes a little gadget that is designed to detect police radar units. Though we haven't tested it, we understand that this is the most sensitive yet made. Just by accident this unit tunes two UHF amateur bands and we highly recommend it for this purpose. 12 v. Sells for $44.95.
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73 Tests The Knight RF Z–Bridge

Larry Levy WA2INM

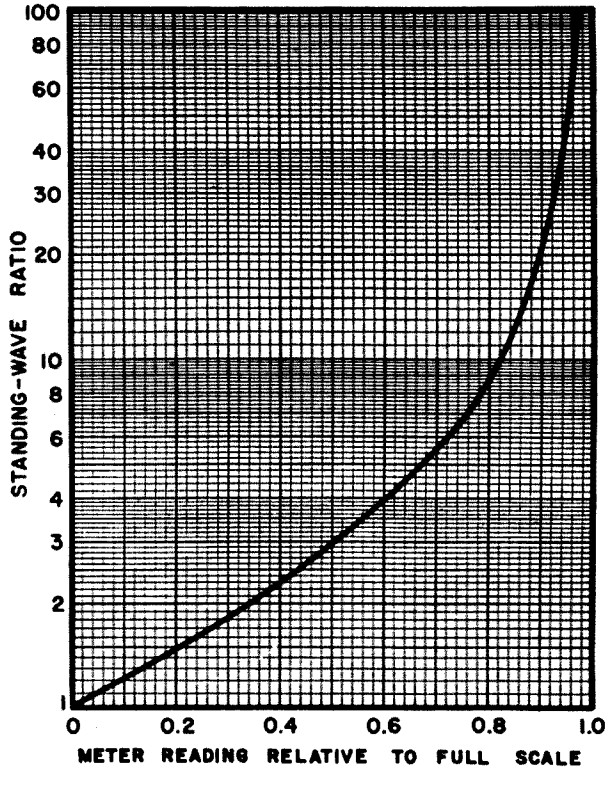


The Knight "Z" bridge is a very useful and inexpensive piece of test equipment. This is a necessity to anyone who wants to tune his antenna. The "Z" bridge can be used to measure antenna impedance, adjust antenna couplers, matching networks, and tune antennas to resonance. It can be used from 100 kc to 144 mc, therefore covering the 160, 80, 75, 40, 20, 15, 10, 6, and 2 meter amateur bands. It requires the use of a VOM or VTVM measuring 0-2½ or 0-5 vdc. If a VOM is used it should have a sensitivity of at least 5000 ohms/volt. It is also necessary to have a source of rf at the frequency that the antenna will be operating on. This should be about 1 watt in order to prevent damage to the bridge, which is not an instrument that can be used with any power. Just loosely coupled to the xmtr should suffice.

One of the most useful, and probably the most popular, uses of the bridge is to measure SWR. Most hams would like to have an SWR bridge, but usually don't buy them because of the cost. If that is your trouble, the "Z" bridge is the ideal answer, as it only costs $5.85 for the complete do-it-yourself-antenna tuning, matching, and SWR measuring kit. Figure 1 shows the relation between forward and reflected power to SWR. By using this chart with the bridge it is possible to measure SWR accurately. There is a plastic chart included with the kit that can be used for a long time before it falls apart.

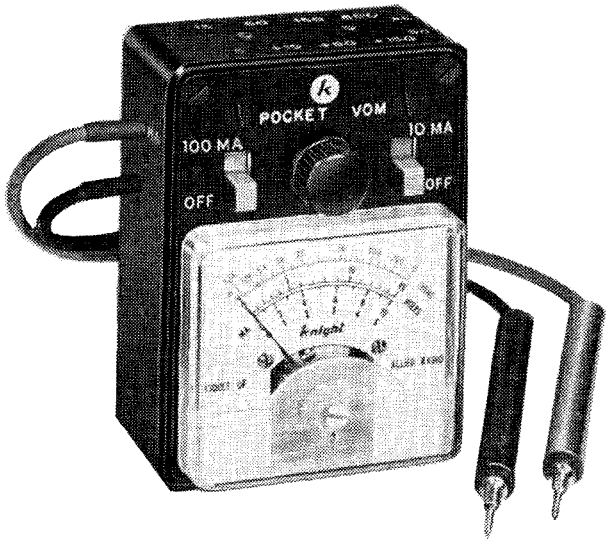
The kit can be put together in about a half hour, as there are no critical steps or extensive mountings. Included with the kit is wire, solder, hardware, a 72 ohm precision resistor (for calibration) and, of course, the parts. The instruction book is well written and the manual contains step by step instructions for wiring each part. There are a few large, easy to see, pictorials to help the inexperienced builder, and even the experienced constructor can use them to save time and make a neater job. The last half of the manual contains detailed instructions on how to use the bridge for impedance measurements, SWR, tuning the antenna to resonance, obtaining the best match, measuring the standing wave ratio on parallel lines, measuring impedance on parallel lines, and other uses. There is, at no extra cost, a section on how to solder. This is definitely an instrument that can be used by any ham for many things and, at the low price of $5.85, an instrument that you surely cannot afford to be without.

. . . WA2INM



73 Also Tests The Knight Pocket VOM

Larry Levy WA2INM



The Knight pocket VOM is a 1000 ohm per volt VOM that is both inexpensive and compact. The dimensions are about 2½ x 3-¾ x 1½ inches, small enough to actually fit in your pocket. Even though it is small, it is a high quality instrument. The ranges are: dc volts 0-5, 15, 150, and 500; ac volts 0-5, 15, 50, 150, and 500. dc ma. 0-1, 10, and 100. Ohms, 0-30k. There is no crowding of parts because of the novel arrangement of range switching. Instead of a switch, there is a jack for each range. This not only simplifies construction, but also accounts for its small size and low cost. The VOM costs $9.95 complete with probes and battery. It features a large, easy to read 2½ inch meter. The construction takes about an hour and the result is a handy, compact, and portable instrument. This is just the thing to have if you have to climb a tower to check for a break in the coax (you can also qualify for a life subscription at the same time if you do it habitually).

. . . WA2INM

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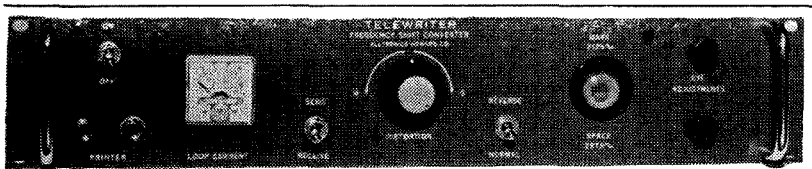


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73 Tests the Hallicrafters HT-40K

Donald Smith W3UZN
Associate Editor

THE Hallicrafters company has added to its line two kits, the HT-40K and a receiver, the SX-140K. The transmitter is housed in a typical Hallicrafter two-tone gray cabinet, runs 75 watts input on CW and controlled carrier AM phone operation. It covers the 80 through 6 meter bands.

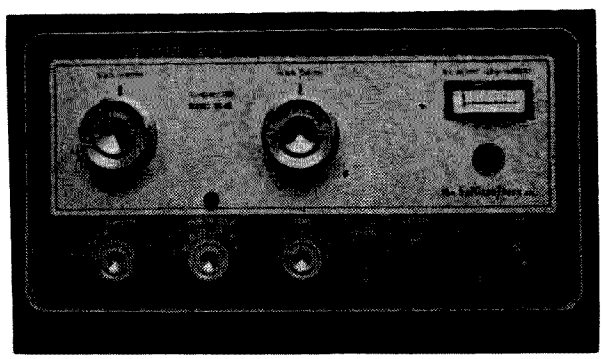
Specifications of the rig:

Oscillator	Crystal control or external VFO
Power input	75 watts CW 75 watts controlled carrier AM phone
Frequency coverage	80, 40, 20, 15, 10 and 6 meter Amateur bands
Audio input	.004 volts minimum from microphone — Crystal, Ceramic or Dynamic type
Output	50-75 ohms unbalanced coax, Pi-coupled
Power requirements	105-125 vac, 60 cy, 175 watt power consumption
Dimensions	7-3/16" high, 13⅜" wide, 8¼" deep
Net Weight	17 pounds
Price (Kit)	79.95
Construction time	Approximately 8-9 hours

Hallicrafters has put a lot of thought and engineering into their new kits. The manual is very comprehensive, with many illustrations and even complete information on how to solder for the newcomer. Each part is in a separate, transparent bag, with the part and diagram number on it.

Circuit Description

A 6CX8 (triode section) is used as the crystal oscillator in a modified Pierce circuit, receiving feed-back from the plate of the oscillator through a 4700 mmfd capacitor (C1). The output of the oscillator is developed across an RFC and coupled to the buffer-multiplier through a 1000 mmfd capacitor. If VFO operation is used, feedback from the oscillator plate is removed by the xtal-VFO switch. It is not



even necessary to remove the crystal.

The buffer is the pentode half of the same 6CX8 used for the oscillator and operates straight through on 80 meters and doubles or triples on other bands. The output of the buffer-multiplier is not tuned, but has the output developed across a 1 mh RFC. This output is connected to the band switch, to be coupled to the final amplifier.

The final amplifier is a rugged 6DQ5 tube, with the grid circuit tuned to the operating frequency and operates straight through, with the exception of 6 meters. On 6 meters, the frequency is doubled in the final. The final plate operates into a pi-coupled circuit on all bands. A diode is connected to the output of the coupler to rectify a small part of the output signal. This rectified signal is connected to the front panel meter, giving an indication of the output. Note that the final is not "dipped," but rather peaked for maximum indication on the meter. A switch is provided to read this output signal or to read grid current of the final. In the grid current position, the meter which is divided into 5 divisions, will read to 5 mils, one mil per division. In the output position, each division indicated on the meter is approximately 10 watts of rf output power. Thus the output power of the rig delivered to the antenna can be closely estimated.

The speech amplifier consists of a 12AX7 tube, one triode being used as a mike preamplifier, rc coupled to the second triode section of the tube, which is the first audio amplifier. The gain control is placed in this stage. A second audio amplifier is used, which is one triode of a 6DE7 tube, the second triode being the modulator. The second audio amplifier is direct-coupled to the modulator.



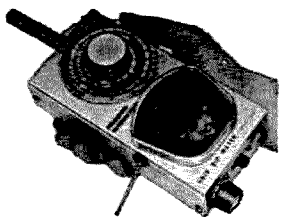
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GRID DIP METER

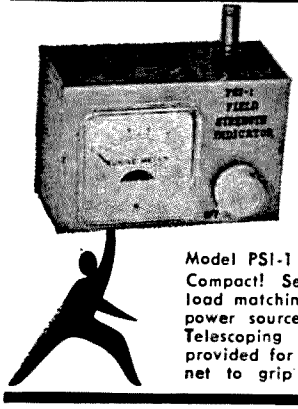
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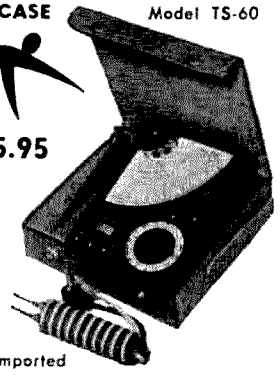
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- Compares with 4½" meters
- Measures 3¼"W x 4½"
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DC V. ranges: 5-25-250-500-2500 @ 20,000Ω per V.
AC V. ranges: 10-50-100-500-1000 @ 10,000Ω per V.
DC current: 50 μa, 2.5 ma. Imported



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CW operation is accomplished by keying the cathode circuits of all stages in the transmitter section of the rig. A jack is provided for this purpose on the front panel, as if to encourage CW operation.

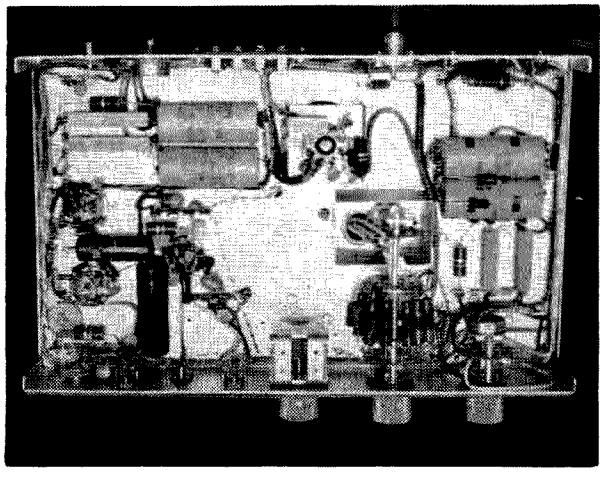
The design of the modulator is such that the modulator has low plate resistance and acts as a high level cathode follower. The screen of the final has considerably higher impedance and thus becomes a considerable portion of the cathode follower impedance. The audio from the cathode follower (modulator), is applied to the screen of the final through a .47 mfd capacitor and of course modulates the screen of the final in normal, controlled carrier fashion.

The power supply is transformer operated and uses a voltage doubler circuit (full-wave), to develop the high B+ voltage. Diodes are used for rectification, cutting considerably the heat which is characteristic of tube type rectifiers. Filtering is accomplished by a pi-type filter circuit, with a filter choke being used in the pi, for better filtering. RFC chokes and capacitors are used in the line to minimize TVI.

The kit was easy to build and went together smoothly. A cabled harness is furnished for the long runs of wire, simplifying and making a neater job of the wiring. In the final assembly you begin to see just how attractive the rig looks. The final tuning and loading knobs are large, helping to make tuning easy.

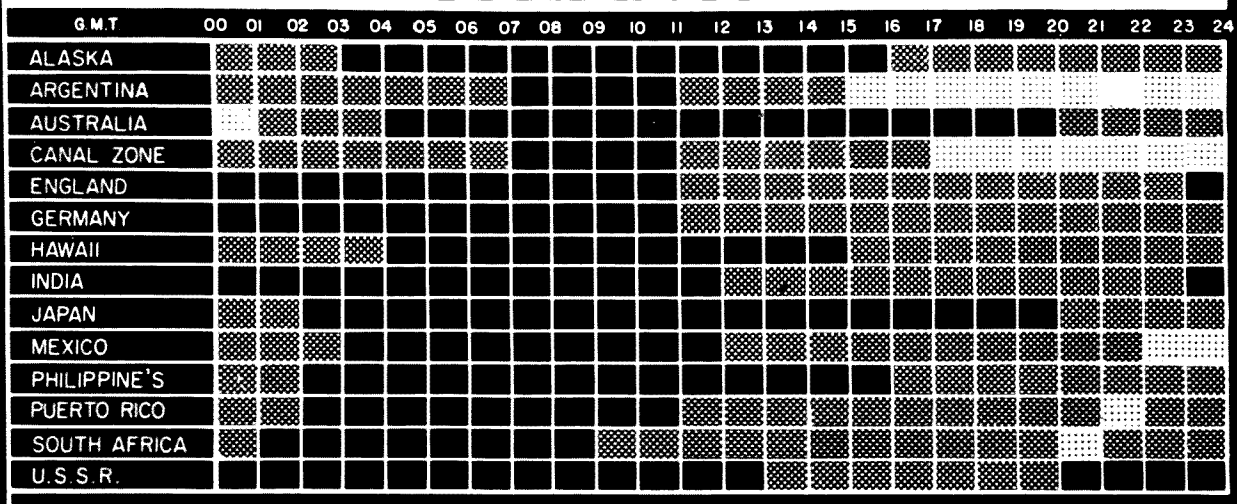
Tune up is very easy; only the drive capacitor and final tune and loading need be adjusted. It is impossible to tune the drive control (a capacitor in the final grid circuit) to a harmonic of the operating frequency, due to the selection of coils used in the grid circuit. Output into a dummy load was 43 watts on CW and 39 watts on AM phone peaks. On 6 meters this output was somewhat less, no doubt due to doubling in the final.

I think that Hallicrafter with their entry into the kit field has put out a rig which will be of interest to many amateurs, particularly the newcomer. It has reasonable power output, simplicity of construction and good design coupled with looks and a well known manufacturer. . . . W3UZN

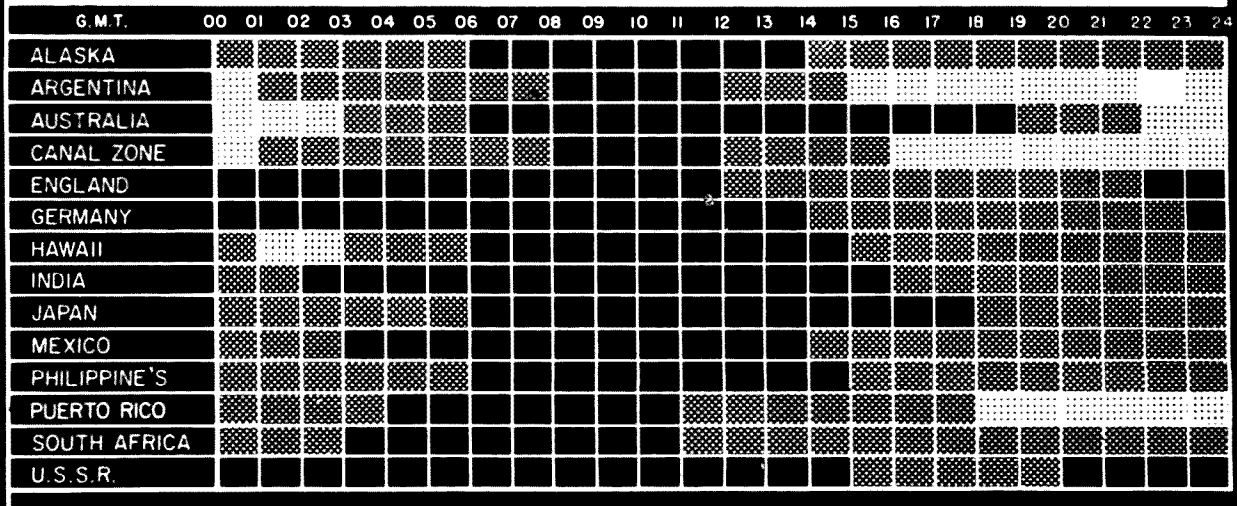


PROPAGATION CHART

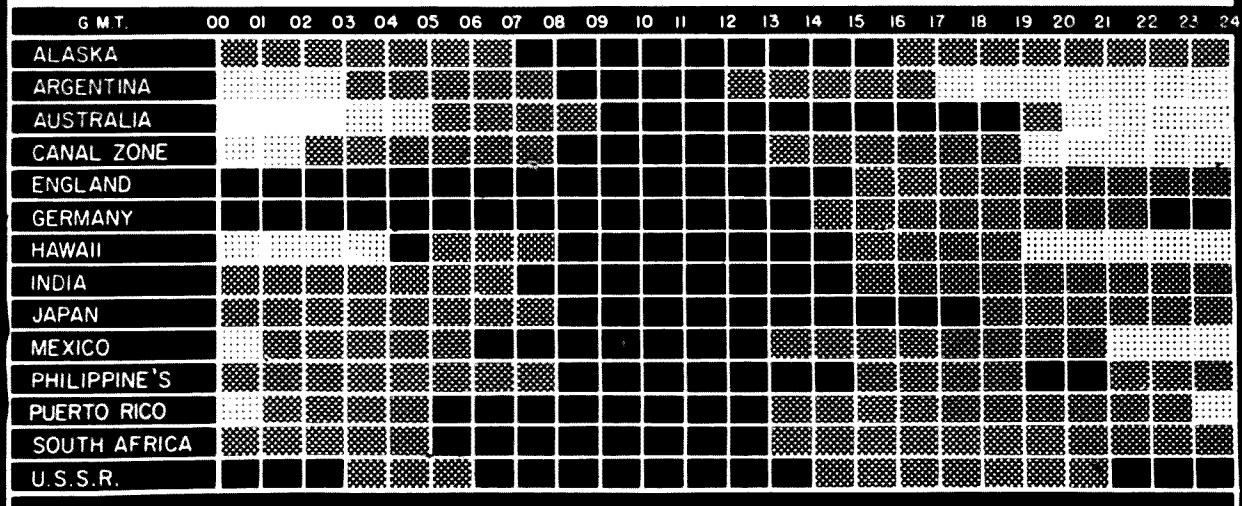
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Propagation Charts

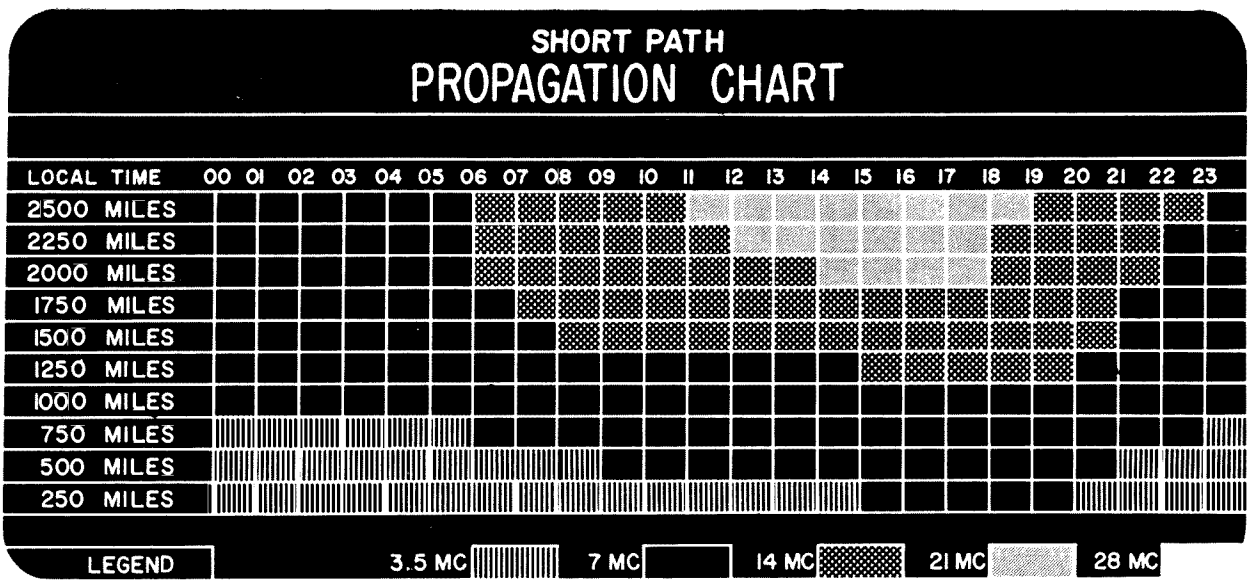
David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

Advance Forecast: May 1962

Good: 1-2, 5-6, 9-17, 23-30
Fair: 3-4, 7-8, 18, 22, 31
Bad: 19-21



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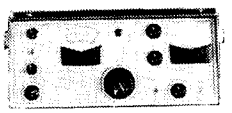
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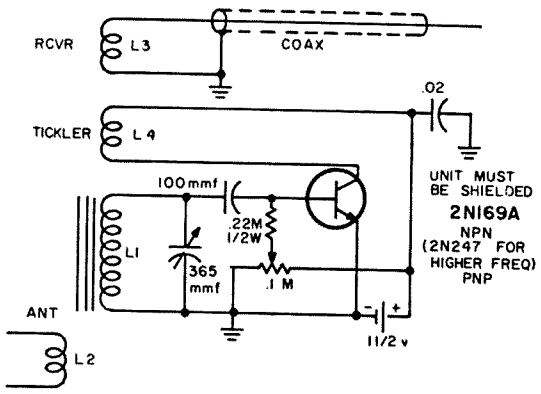
Gus Gercke K6BIJ

Q Multiplier at the *if* input is a familiar gadget. What it does (and that is-narrowing your *if* passband) is accomplished by introducing some regeneration at the *if* input making it high "Q".

It does nothing to improve Image Rejection, or to lessen the effects of Crossmodulation (overloading the mixer by a strong near by signal).

Much more logical place for a "Q Multiplier" would be at the rf Section—where it will reject the image and improve or eliminate crossmodulation. Why then is it used in the *if* Section only? Here are the reasons:

1. rf "Q Multiplier" has to be tunable and (at maximum selectivity) will not track as a normally broad rf Amplifier does. This means additional controls.
2. An attempt to use one was made in "Regenerative Pre-selector"—it failed because it had mostly *gain* and not *selectivity* in its design.
3. Nobody tried.



The following gadget was built mostly to prove that it can be done. In order not to dig into the receiver—it was designed as a separate unit, and connects between the antenna and the receiver. It is self powered (drain—50 microamps). With transistor and constants shown it covers both 80 and 40 meter bands.

The theory behind it, though not quite clearly understood, is something like this:

There is practically no coupling between L2 and L3 until L1 is at resonance. Since L1 is a part of a circuit that can be brought close

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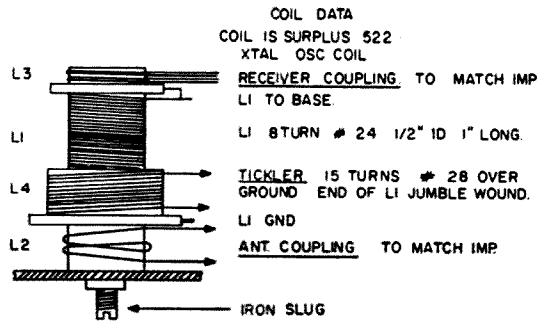
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to regeneration—its "Q" is high, and only a sharply resonant signal will be coupled to L3. This results in a narrower bandpass, by a factor of about 25-30, compared to that of an rf Amplifier, and no doubt can be improved further.

Regeneration is very smooth, and even in this crude form it will be a useful addition to many receivers and converters.

. . . K6BIJ

Including the Kitchen Sink



The amateur constructor who hopes to match commercial equipment appearance must be on the alert for hardware items and construction techniques to incorporate in his projects. In this connection, a pleasing treatment of speaker openings is one problem that often arises.

There is available in the dime stores a chrome plated sink strainer that will help dress up your equipment. This perforated metal disk is shown installed in a previously described[1] conversion of the AN/ARC-3 receiver. The strainer is supplied with a metal retaining clip riveted to the center of the disk. Drill this rivet out and proceed with the installation.

The strainer shown measures 3⅛" in diameter and is manufactured by Franklin Metal & Rubber Company of Hatboro, Pa. For 19 cents you can't go wrong. . . . W4WKM

[1]"Another Two Meter Conversion," W4WKM, Dec., 1961 73 Magazine.

Photo Credit: Morgan S. Gassman, Jr.



Citizen Band Class "D" Crystals

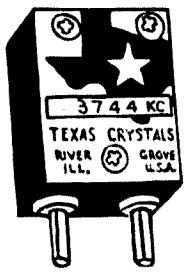
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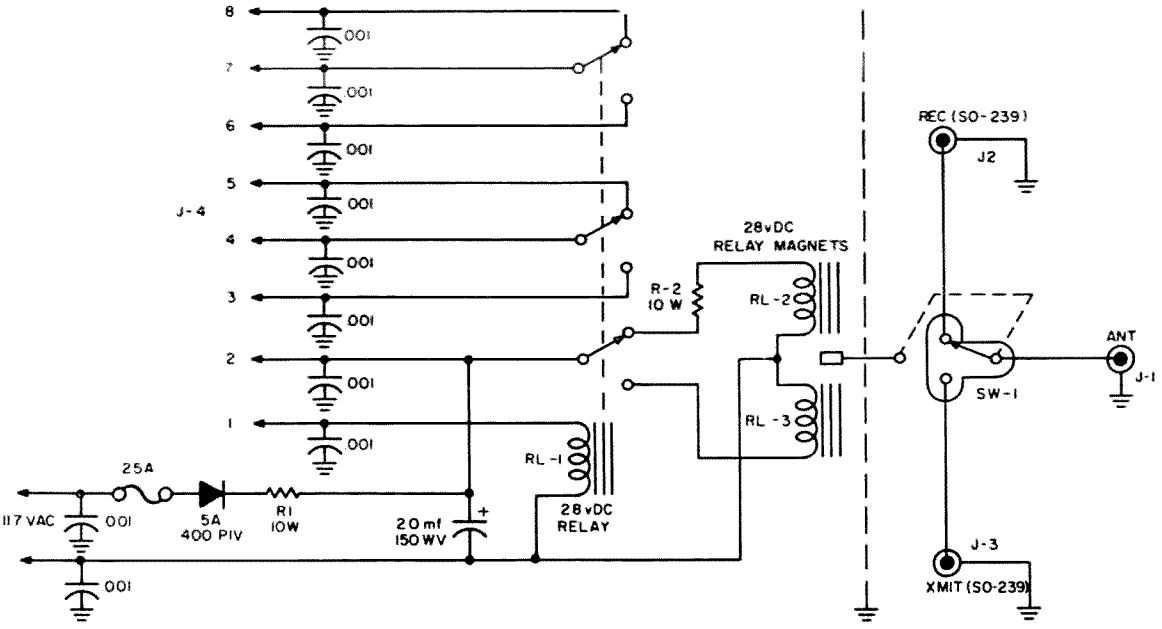
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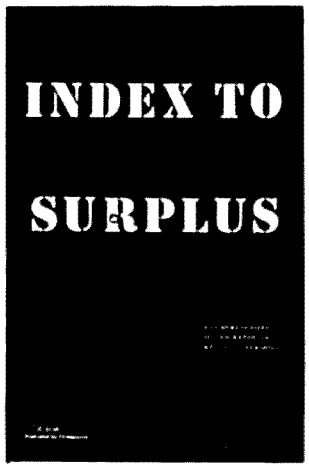
Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photo Credit: Morgan S. Gassman, Jr.

COMMERCIAL coaxial relays are thoroughly reliable devices and should give many years of satisfactory service *IF* the rated power is not exceeded, *IF* they are operated in lines with low SWR and *IF* they are never required to switch with appreciable rf power applied. Failure to observe these precautions will result in the catastrophic demise



INDEX TO SURPLUS



Roy Pafenberg W4WKM has accomplished a major effort in this compilation. It lists every known surplus conversion article, giving a capsule rundown on the conversion accomplished and the magazine in which it was published. If you do any surplus conversion work this book can save you a lot of time by telling you exactly what conversions have already been published. 64 pages packed with information.

Price . . . $1.50

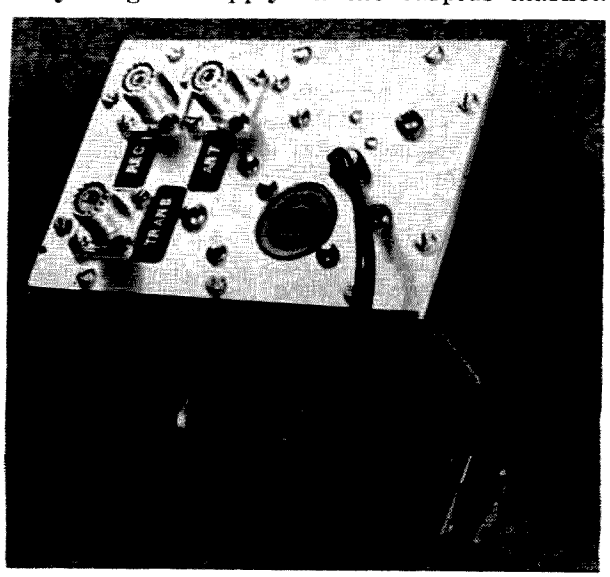
73 Magazine 1379 East 15th St., Brooklyn 30, N. Y.

or deterioration of the relay contacts.

For those who are tired of welded contacts and the smell of burning insulation, vacuum antenna switching relays will stand almost any amount of abuse without failure. The advantage of these vacuum switches cannot be questioned. The writer was once asked to test, to destruction if possible, a number of Jennings units. Two of these relays were installed in a 600 ohm, open wire transmission line to switch a 50 KW transmitter from a rhombic antenna to dummy load. A timer was arranged to switch these relays, under load, at 10 second intervals. The test was terminated after 40 minutes because of transmitter trouble. Although the transmitter output coupling circuit had broken down under the high switching transients, the relays suffered absolutely no damage.

Despite the obvious advantages of these components, their cost prohibits their use in many amateur installations. There is, however, a low cost answer available on the surplus market. The AN/ART-13 transmitter uses a compact vacuum switch in the keying relay assembly. Although the relay is used in the relatively low power AN/ART-13, the switch contacts can handle a KW with ease. High altitude operation and the unpredictable characteristics of military aircraft antennas required an even more generous safety factor than is engineered into most military equipment.

Although the actuator mechanism used in the AN(ART-13 is unsuited to most amateur applications, this poses no particular problem since a more satisfactory device is easily fabricated from surplus 28 volt dc relays. Since a simple power supply is required for the relay magnets, it may also be used to actuate a slave relay and the additional contacts brought out for utility station switching use. Figure 1 shows the schematic diagram of the complete unit. The vacuum switch specified is apparently in good supply on the surplus market.



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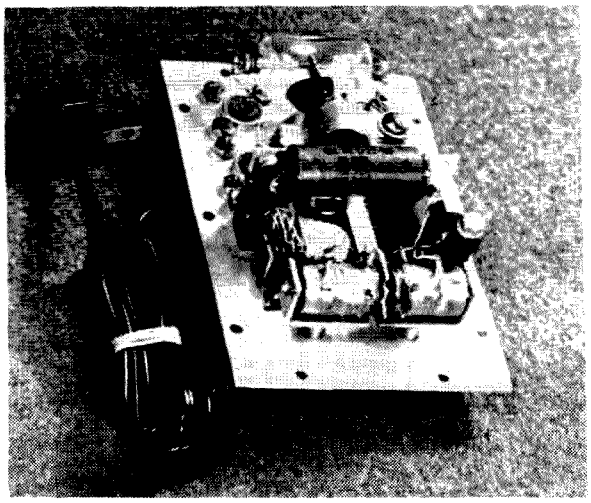
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Fair Radio Sales Company lists the relay at $1.50 under the Signal Corps Stock Number of 3Z9874-4.

The relays shown as RL-2 and RL-3 should have a coil resistance of between 200 and 500 ohms and should be of the type that is easily disassembled. RL-1 is a three pole, double throw unit which, besides controlling the vacuum switch magnets, provides additional control contacts for utility use. Almost any 28 volt dc relay may be used although a small, low current unit is to be desired. R-1 and R-2 should be selected after the equipment is wired to insure 28 volts across the relay coils under both transmit and receive conditions. Since the power supply is required in both modes, ac power should be controlled by the station master switch.

For ease of assembly and to insure adequate shielding, the unit is constructed on a scrap of aluminum cut to serve as a bottom plate for a 4" x 6" x 2" aluminum chassis. Isolation of the control circuitry from the rf switch is provided by the small shield plate that is punched to pass the actuating arm of the switch. The only critical dimension is the spacing between the vacuum switch magnet poles. This should be adjusted so as to provide about 3/16" armature travel.

The contacts and armature should be removed from RL-2 and RL-3. If you are fortunate in your selection, the contact stack mounting holes may be used to secure the magnets to the plate. If not, small angle brackets may be used. In any event, the magnets should be positioned so that the center of the poles lines up with the center of the actuating arm. Use spacers if required. Mount the SO-239 receptacles, RL-1, the octal socket, the shield plate and a grommet for the line cord. Also mount the clip for the diode if the Sarkes Tarzian unit is used. The vacuum switch is mounted by a ¾ or ⅞" plastic cable clamp secured around the metal ferrule of the "antenna" contact. This clamp is mounted

(Continued on page 25)

MD-7

A Cheap, simple plate modulator

Gary Stock WA2PGX
115-77 224 Street
Cambria Hts. 11, New York

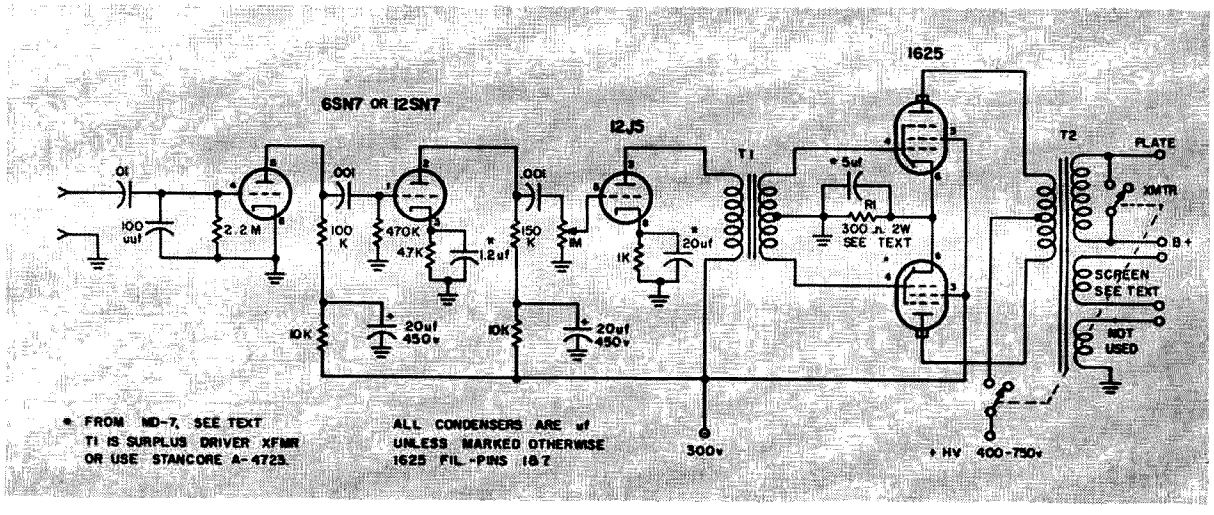
AS the title implies, this modulator is an inexpensive unit requiring a minimum of construction time and chassis butchery. It is just the thing for modulating most Novice or CW carrier controlled phone rigs having anywhere from 50-to 120 watts input. These include the DX 20-60 series transmitters, HT-40, Globe Chief, Navigator, and especially ARC-5 rigs converted for ham use, because these were originally used with this modulator. Using carrier control I found that I could barely get through the first layer of QRM, but now I can push through almost anything. Even more important, the all too familiar report "You're 40db over S-9, but can't you bring up the audio just a little?" isn't heard in my shack any more.

The heart of this modulator is a surplus MD-7, ARC-5 plate modulator which is available locally for about eight or nine dollars, depending on your patience and ability to argue price. One word of caution though, make sure you get an MD-7 and not a BC-456 screen modulator. It is possible to mistake one for the other because of the similarity in their chassis. The MD-7 has two 1625's which are visible when you remove the unit's top plate, the BC-456 has only one. Also, their positions are marked on the unit's cover.

The main part of the conversion consists of adding a speech amplifier to the modulator to make possible the use of a crystal mike or other low output type. A dual triode, a 6SN7, is mounted in the socket originally occupied by the 12J5, while the 12J5 driver tube is placed in the VR-150's socket. This is done to facilitate the parts layout. I had both a 6SN7 and a 6 volt supply available, so I used them. It would probably be wise to use the 12 volt equivalent of the 6SN7, the 12SN7, and the existing 12 volt supply. Also, you can build the unit on a regular chassis. I didn't for two reasons: the tube sockets and transformer were already mounted, and the chassis looked pretty good as it was.

To begin construction, remove the cover plate and remove the tubes to prevent their breakage, then remove the bottom plate. Unscrew all components from the side of the chassis except for one 1.2 mfd condenser, and the dual 5 mfd and 20 mfd condenser; the tube sockets and the two 620 ohm resistors soldered to the 1625 sockets also remain. Remove all wires connected to the plugs at the rear of the chassis and all others necessary to free the components you just released. Leave the wires connected to the output transformer and also leave the wires connecting pins 3, 5, 6, and 7 of the two 1625 sockets together.

Next, remove the mike and key jacks from the rear panel and replace the mike jack with an Amphonol type 75-PC-1M mike connector or its equivalent. (the connector fits right into the original hole.) Remove both fuseholders and their covers, and fit the driver transformer in two of the holes left by the fuseholder on the left of the chassis. My pot fit in one of the holes left towards the front of the driver transformer, right in the corner, and I mounted the dual 20 mfd can on the right of the chassis. All directions referred to are looking at the underside of the chassis with the 1625 sockets to the rear. Mount the AM-CW switch on the front panel to the left of the square condenser, and mount your output socket in the space previously occupied by the three-prong dynamotor



connector. This connector is easily removed by prying it up with a screwdriver. The actual wiring of the unit is straightforward; follow the usual wiring procedures and run the long lead from the 6- or 12SN7 to the gain control with shielded wire. The wires can be laid out for convenience in lacing if you wish, but this is not necessary.

As a final note I would like to say that the switching arrangement I have shown is most suited for my rig; however, all that is required is that the AM-CW switch shorts out the secondary of the modulation transformer during C.W. operation and that there is provision for removing the high voltage from the plates of the tubes at the same time.

There are two outputs available on the transformer; one is roughly 6000 ohms and is a close enough match for most tubes operating in the vicinity of 600 volts at 150 mils such as the 807, 6146, 1625, and 6DQ5. This is only a partial list. The reason that you can match quite a few tubes is that the 1625's are running at about half their rated output and as such are very non-critical as to loading. The second output is a screen winding and this can also be used for most tubes with no ill effects. I used this winding when modulating my HT-40 because it has the screen tied to its own supply, and I came up with excellent results.

This ends the list of gory details associated with building the modulator; so, if you have dispensed with the proverbial smoke test, connect the rig, modulator and power supply and let everything warm up. Tune the rig in the CW position into a dummy load and turn the modulator on, making sure that the unit is in the AM position and that the transformer is not shorted out. When you talk into the mike, the lamp's brilliance should vary with your voice intensity. Adjust the gain control until it just brightens on voice peaks. The best way to properly adjust the unit is with a scope, but since most of us don't have one, here is an alternate method. Have someone with a crystal filter in his receiver listen to your signal as you bring the gain up. When you just begin splattering, reduce the gain a trifle and you're in business.

In general, you should have no trouble building the unit or getting it into operation, and you will find that the modulator has plenty of reserve punch, even when delivering a full 60 watts of audio. Also it will make an excellent driver for any high level modulator, so the unit really will be a good, long term investment.

...WA2PGX

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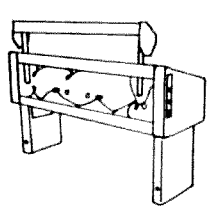
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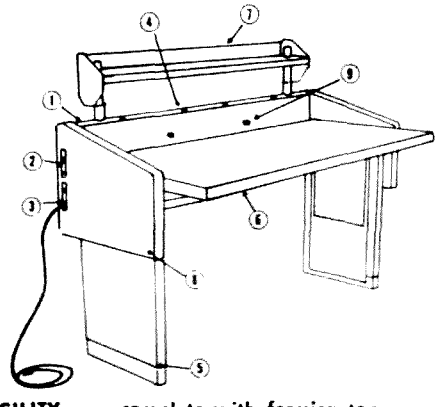


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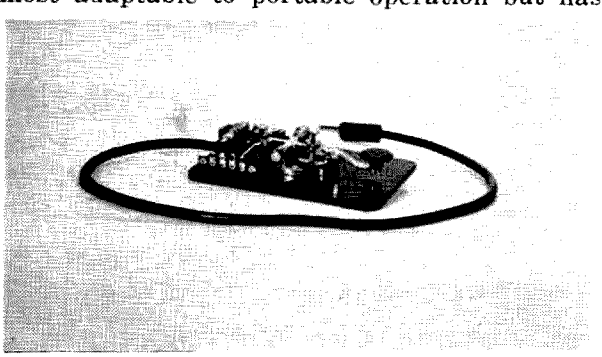
Howard S. Pyle
3434 74th Ave., S.E.
Mercer Island, Wash.

FOR many years I traveled throughout most of the Western states in connection with my profession. Being an ardent ham I wanted to take my gear with me and this often presented some major as well as many minor problems. One of the latter was to make the key "stay put" when set up in a portable location. You can't make screw holes in a hotel or motel desk or table without either an argument or a "pay-through-the-nose" price to the management! On the other hand, you don't want to chase your key all around the operating surface while trying to make decent code characters which are reasonably decipherable by the stations whom you contact. What to do?

Several years ago I solved this problem by contacting a local metal fabricating shop and having a piece of black iron, or "boiler-plate" as it is known in some localities, cut to a reasonable size and of a thickness which guaranteed sufficient weight to hold the thing in place on the operating surface. The most practicable size and weight which I found, was a piece ⅛" thick and of a dimension of 4" x 7" and which weighed slightly less than three pounds with the key and click filter mounted. For one dollar, the metal shop turned out a piece like this and ground the four corners down at a ½" radius which eliminated the sharp edges which could tear clothing . . . and flesh! Using this basic metal base I positioned the key symmetrically, drilled the two mounting holes and tapped them for 8/32 flathead machine screws. This done, the base was given a coat of gloss black enamel for the sake of appearance as well as rust-proofing. A small piece of felt (10c at the local variety store) was then glued to the underside of the base; you wouldn't want to scratch the table top would you?

Such an arrangement has proven not only most adaptable to portable operation but has been found to be a very convenient arrangement for the key at the fixed station at home. With a flexible cord and a plug to insert in the transmitter keying jack, the "creeping" problem is readily solved. Your key will stay put and you'll also have plenty of room on the base plate back of the key to mount a condenser, choke and resistor . . . one or all . . . whatever you find necessary for a key click filter, if you need one.

A "bug" key may, of course, be mounted on a similar base if you prefer, in place of a hand key. . . .W7OE



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. . . W9SLM

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Letters

Editor 73

Yesterday, March 28, propagation conditions were the worst I have observed in many a moon. A quick check of Dave Brown's predictions in the March issue, made a couple of months in advance, indicated that the only bad day in March would be the 28th! That's what I call top notch forecasting. It is significent to note that George Jacob's March predictions in "CQ" listed four exceptionally good days for March, one of them being the 28th!! You can draw your own conclusions.

Gil Countryman W4JA (ex W3HH)

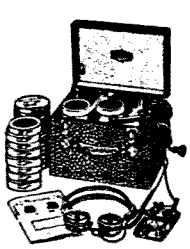
Dear Wayne,

I am writing in regard to the article I wrote, "One More Use For The BC453." In the article I quoted XL1AAX as saying the 6AR8 is as extinct as the dodo bird, and suggested the use of the 7360 or the 6BU8—so far so good. This week I had the chance to try the 6BU8 in the circuit. I did what I feel some one else might do. I installed the tube without checking the specs and developed a very microphonic tube. After checking, I found that I should not exceed 150 volts on the plate. When I corrected this goof all was FB. I then put the 6AR8 back in and found that 150 volts seemed to make no change in the original unit.

If the article's schematics have not been redrawn as yet, would you change the voltage that supplies the 6AR8 and the IF amp to 150 volts MAX. If it is too late, please print it in the "goof column" as the author's error.

Dick P. Gridley K6JHJ

Too late . . . ed

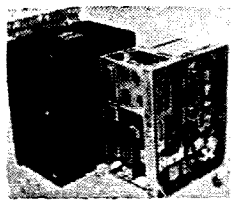


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(W2NSD from page 4)

modification of the G4ZU tri-band beam got a lot of votes. Here is a tri-bander that has no loading coils or traps and can be tuned right from the shack. W9HOV compares the attenuation of different types of coax to open wire line on the various ham bands, making it apparent why few VHF DX men are using coax. K2IGY went way out on a limb with his predictions of propagation conditions to come. Dave predicted a much shorter sunspot cycle than the National Bureau of Standards or W3ASK. So far he has been a lot righter than anyone else, erring only on the conservative side. The Lafayette KT-200 receiver is reviewed and found to be a lot of receiver for the money. In the test equipment line we have the Vary-Volt, a little device which gives you from 97 to 132 volts ac output for trouble-shooting.

Dave Bell W8GUE provided us with a fine first hand report of the first moonbounce QSO as heard from W8LIO in Ohio. Illustrated. K2TKN provided us with a chart which enables us to calculate how much power, what size antenna, etc., is needed to establish contact via the moon on the different ham bands. W2OKU, one of our local Porsche-Pushing hams, ran a fine test on the Knight G. D. O. You get a lot for the $22.95 involved. W4WKM told us how to buy precision resistors at a bargain and then move them to the resistance that we desire. We were sort of specializing in test equipment in May. Another article that has brought a lot of requests for the issue is on calibrating volt-ohmmeter ac scales. K5JKX had a great idea in his Ohms By The Yard. With this you can build a simple resistance box which will give you an accurate voltage divider or potentiometer within amazing limits. You can choose an output voltage, for instance, anywhere between 50 and 150 volts to the nearest .01 volt! W3KET gives us some charts on blowers so we can figure out what size we need for which application. Our big technical article for May is on the audio amplifier part of the receiver. Various methods of achieving audio selectivity are discussed.

Again we had many more pages of technical and construction articles than the other magazines. Send for a copy, 50c.

Dagnabit

The March issue contained some of the most horrendous errors we've yet managed. Thank heavens they are rather obvious (to everyone but me when I'm rushing) and were probably corrected when you read the articles. The first misery was in the VFO schematic on page 6 where the screen and control grids were switched on the 6AH6 and 6CB6's. We tried a new draftsman just to see how it would work. Not so good, eh? The bottom of L2 should get some B-plus. The RFC is the usual 2½

mh. If you get the circuit board from Irving Electronics or make it as described you won't get into any of these troubles.

K5CKC/6 went to the trouble to do what I should have and worked out the formula presented by W2KPE and found that the line should be 22.7 feet, not 27.7 feet. Ugh on W2KPE and on me for not checking with the slide rule. Change that on page 27.

Oscar

This project has been so extensively covered in the other ham magazines that I didn't see much purpose in printing more of the same. The fellows involved are to be commended for helping to put ham radio into public view. Publicity like this will be of great value to the hobby. Let's get more of those gadgets up there fellows.

One of the local space hardware manufacturers called to find out if we might be interested in getting the hams behind the construction of another satellite, one which would furnish us with a frequency standard. With the price of calibration oscillators where it is now I guess we don't need anything so fancy.

Commercial Notes

Waters Manufacturing is really going into the ham market in a big way. In addition to their hybrid coupler (phone patch) they now have added a nice looking coax switch and some notch filters for the Collins owners that fit right into the units just as if they were original equipment. Watch for their new RF power meter with built-in dummy load too.

Gavin Instruments will be introducing a fine little two meter band pass TVI filter next month, thereby adding to their present line of six meter and all-band filters. Gavin has been working night and day to keep up with the demand.

New-Tronics had a winner in their contest. Their new line of all-band mobile whips will now be called "The Hustler". Some 6000 fellows wrote in with entries and hopes of winning the KWM-2. Now aren't you sorry that you didn't give it a try? K8VZU, John Nowacki (16 years old) if the winner, say hello to him on the air.

Barker & Williamson put their new rig on view at the SSB Dinner in New York during the IRE show and attracted a lot of attention. The 6100 uses a crystal synthesizer, the first one to appear in ham gear so far. The dial is resettable to 100 cycles!

P & H has done a lot toward bringing SSB to six meters. Their 6-150 transmitting converter works like a charm and is getting very popular. We'll have a review of this rig soon.

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AMATEUR RADIO

73

June 1962
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27 Feature Articles

Special VHF Section

73 Magazine 1379 E. 15 Street—Brooklyn 30, N. Y. June 1962 • Vol. VII, No. 1
Wayne Green W2NSD—Editor, etcetera Phone: DE 6-8880

Echo Deluxe ..... John Wonsowicz W9DUT 6
Two meter transmitter with a commercial appearance.
The Friendly Frequency ..... Lloyd Hanson W9YCB 14
52.525 mc.
Six and Two Meter Nuvistor Pre-Amplifiers ..... John Lange K9ARA 16
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Runs directly from your 12 volt system.
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Explore these long-forgotten frequencies.
A KW/SWR Power Meter ..... James Lee W6VAT 26
You can leave it in the line if you want.
Selectivity Plus ..... Marion Culver W9OFD 30
Putting a mechanical filter in the home-brew receiver.
Overload Relay ..... Harvey Pierce WØOPA 34
Beats fuses all hollow.
73¢ Noise Clipper ..... James Garrity KØWML 36
A good price. Connects between receiver and headphones.
Tape Recorder on SSB ..... Ted Wilds KZ5SW 38
Use tape loops for those long, long CQ's.
Phase Inversion ..... Dean Cupp W4JKL 40
Hi-fi on the hambands? Forsooth!
Electronic Keyer ..... Al Brogdon K3KMO 42
Cheap, simple and effective. Get cracking!
Pop Box ..... Tom Lamb K8ERV 44
Now you can generate your own ignition interference. Make friends with the neighbors.
Selected Circuits ..... Roy Pafenberg W4WKM 46
Looking at the RF Communications Assoc. sideband transceiver.
Diathermy ..... Roy Pafenberg W4WKM 50
If it isn't too late you might grab any available units.
160 Meter Converter ..... Hank Cross W1OOP 52
Lots doing down on 160, but maybe your receiver doesn't cover the band.
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Break-in CW with the 20-A ..... Donald Bramer K2ISP 58
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73 Tests the Knight Kit Code Practice Oscillator ..... Larry Levy WA2INM 56
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Values, Etc. ..... Jim Kyle K5JKX 86
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. . . de W2NSD

. . . never say die

Europe has been visited. In the very best tourist traditions Virginia and I shopped and photographed our way through Germany Austria, Italy, Switzerland, France, Belgium, Luxembourg, and Netherlands. Rather than devote the next twelve issues of 73 to a detailed account of our trip and visits with DX hams, I'll try to encapsulate some of our impressions from time to time for you. The basic discovery of the tourist in Europe is the differentness of everything.

Travelling, as should be obvious by now, is one of my enthusiasms and as such is one more of the things which I try to pass on to others. One of my basic character faults is my innate wish to share pleasures with others rather than just enjoying them myself. This manifests itself as editorials on Porsches, Europe, and the like. I suppose that I am being completely impractical, but strange ideas come to my mind such as ham-club tourist flights to visit ham clubs in major European cities, or even a round-the-world flight with ham gear on the plane, etc. I suppose that trips like this would be way beyond the means of most amateurs though and probably are not something to promote in 73. A twenty day tour of Europe would cost at least $500, including jet round trip fare, an unlimited rail pass for Europe, food and lodging.

Berlin

The strongest impressions of our entire European trip came from our short visit to Berlin. We had, like everyone else, seen pictures of the wall and read many stories about what it is like behind the iron curtain. It was still quite an experience to actually see it in person and see the wreaths marking spots where East Berliners have been killed trying to escape from Communism. It was impressive to see the health and vigor of West Berlin, with its crowds of people, filled stores, busy restaurants, and heavy traffic and compare this with the almost completely deserted streets of East Berlin, where much of the war damage of 1945 is still in evidence and what few people there are around do not dare even look at you.

Perhaps we should keep in mind that only a few voices are now able to get through the curtain: those of a handful of tourists who are mostly kept separate from the people by the ever present Intourist Guide, the reading matter in the few magazines that are able to pass through (they cannot send out money for subscriptions), the radio programs from the Voice of America and Radio Free Europe and radio amateurs. Of the lot we stand the best chance of actually speaking on a personal basis to those behind the curtain. We have to be careful though and not get them in trouble. Probably one of the best approaches is to remember that there are a lot of SWL's there and try to put our best foot forward whenever we are transmitting a signal that might be heard behind the curtain.

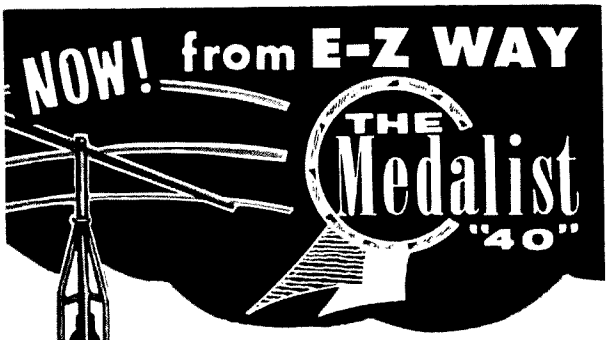
If the countries behind the iron curtain are as different from the U.S. as those in the rest of Europe then I suspect that the people there have very little idea what it is really like over here. In talking with European amateurs I found that few of those who had not actually visited the U.S. really had a concept of what our country is really like. We are judged as a whole by the few Americans they have seen. Uufortunately the ones that stand out are the noisy overbearing ones, the rest being generally mistaken for English, etc. It is quite possible that they don't know any more about us than we do about them, eh?

International Ham-Hop

An informal sort of club has evolved, made up of hams who are interested in playing host to visiting amateurs from other countries. The Ham-Hop Club is fairly well established in Europe, with members in most of the larger cities and most of the countries.

Maybe you are interested in this. If you plan to do any traveling you would do well to join the club and let them put you in touch with amateurs in the various countries you plan to visit. Many of these chaps can put you up for a day or two and will be glad to take the time to show you around and head you toward the more reasonable but good restaurants. One of the great joys of travel is the meeting of people in new countries and being able to sit down and learn about them and their country. In return you give them better perspective on our country and yourself. You will be amazed at the strange ideas they have gathered about the U.S. from what few tourits they may have encountered and the movies they have seen.

If you aren't planning to travel it is every bit as enjoyable to have a foreign ham stop for a brief visit with his wife and get to know



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more about them and their country. You'll learn more about the world in a few minutes of this than you will from any documentary movies or travel books. It is a lot of fun to take these visitors out and show them your town. You should remember that our prices on everything are half again to double anything they are familiar with and to add to the money problem, they probably make a lot less than you do to start with. Make things as easy as you can for them.

Travel in the U.S. is very expensive for the European, so if we can get together and encourage them to come over and enjoy our hospitality through the I.H.H.C. we can do a lot toward international friendship. If you are interested in joining the club drop a note to the U.S. representative W8SZF, 3075 Scarborough Road, Cleveland 18, Ohio.

Repeater

It is heartening to find the old amateur experimenter spirit still popping up here and there. A note from the Arizona Amateur Radio Society says that they are now planning to install a two meter repeater station on Madera Peak near Miami, Arizona (7300 feet up) which should enable anyone in the state to reach anyone else. The repeater will be controlled from Phoenix on 10,000 mc. I sure hope we see some articles coming out of this effort.

Old Man Bites Back

My little piece on the place of certificates in our hobby last month, together with my gentle chiding of people calling themselves OLD MEN, brought a fast, if not concise, response from an OLD MAN. "...stupid...ill advised...half-cocked ... obnoxious...cussing you...don't have brain one...misfit clown... odd-ball...screw-ball...damn fool...crazy... degenerated...garbage...soap-box outpourings ...prankster...", etc. It offends my false modesty to fill the magazine with all this talk about my attributes, so those of you that have a morbid interest in the full text can have one for the price of a stamped envelope. It isn't worth it.

April Correction

The scope monitor, on page 62, should have isolating condensers (.01/1000 v) in series with the arrows coming from pins 8 and 11 of the scope tube. Makes it work better.

April 6M SSB Transmitter

A note from the author catches an error in the schematic which you will want to change on page 7 of your April issue of 73. T2 should shunt C7 and T3 should shunt C8. Put in that

(Turn to page 90)

New! "Valiant II"

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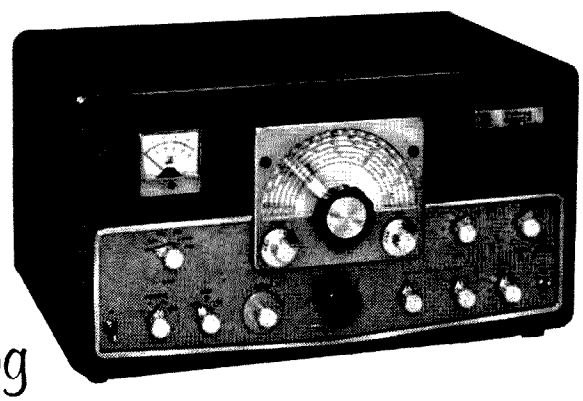
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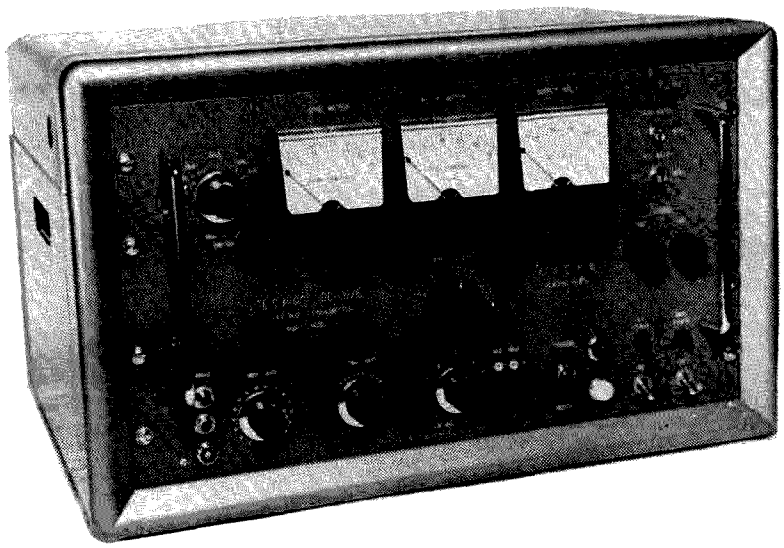
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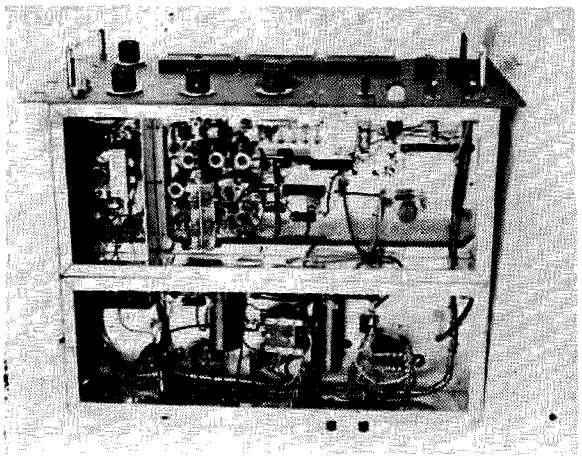
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John Wonsowicz W9DUT
4227 North Oriole Avenue
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THE two meter transmitter described in the following pages resembles a gallon type powerhouse, however this may surprise you, it is only a 25 watter. The reason behind such construction is better efficiency, good reliability and ease of service. Although such construction is practiced by many commercial manufacturers who stress reliability, some of the whole hearted amateurs who are forever making changes and adjustments to their gear will shy away from it. The remaining minority that take pride in building something with eye appeal and excellent innards will find this rig to be a challenge worthy of undertaking.



Bottom view showing the arrangement of coils and a shield between the rf section and the modulator. The bottom of UTC modulation transformer can also be seen in the power supply chassis.

As you can judge from the photos, the design work required quite a number of hours, not to mention the time of construction; but emphasis was placed on performance and followed through. Although the power input is relatively small, the final amplifier delivers a sting worthy of notice, as can be attested by its proud owner K9EPB.

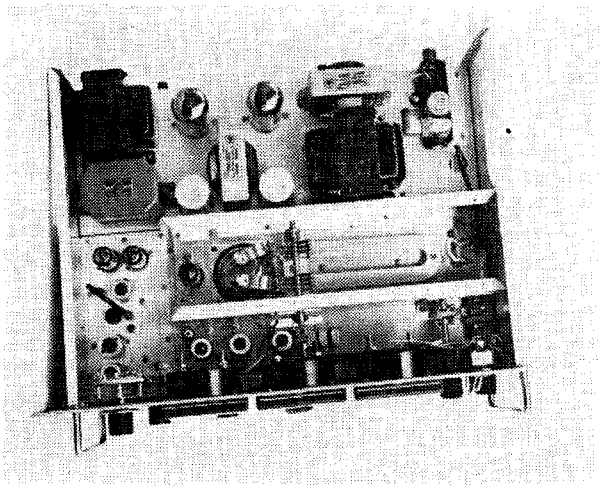
The final amplifier section built around the trusted 832A and using a High Q aluminum tank circuit previously described in 73, represents the nucleus of this power package. This amplifier which is housed in an aluminum shield together with its 6360 driver is shown in the photo.

Multiplier stages located between the front panel and the P. A. enclosure are broad banded and require no adjustments when switching crystal frequency for any "one megacycle" segment in the two meter band.

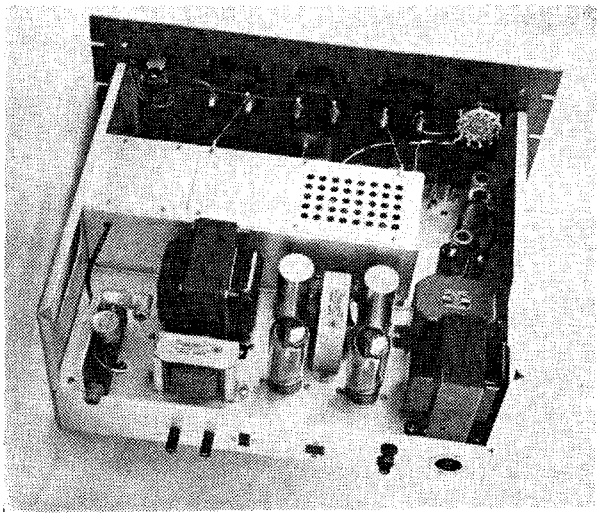
Crystals are of the 8 mc type and are switched in from the front panel. There are 4 crystals behind the panel and one "net" frequency crystal socket on the front panel for easy access to pet frequencies.

Three Simpson meters are provided on the front panel for monitoring all circuits. This includes grid drive to all stages as well as reading plate current and voltage of the power amplifier and current and voltage to the modulator.

The rf module which is complete from crystal oscillator to the final amplifier is forced air cooled. The blower is not shown in the photo, but it is fastened to a bracket and installed as the last item after wiring is completed. The bracket is secured by two screws to the side of the main chassis just opposite the 6360 tank circuit. The complete modulator which is built on a separate 4" x 7" aluminum plate develops 17 watts of audio in class A B 1. This is more than adequate for 100% modulation of the final amplifier operating at the calculated input. A speech clipper and filter is also added to raise the average talking power without sideband splatter. Three different types of mike connectors are used to add flexibility in making a microphone choice, and a modulation gain control is provided on the front panel to offset some weak output mikes.



Top view of the transmitter with cover over the final amplifier removed. The slug tuned multiplier coils can be seen between the amplifier shield and the 6C4 tube shields.



Back view of the completed transmitter. The gear drive of the final amplifier capacitor can be seen under the middle meter.

The two husky well filtered and hum free power suplies are built on a separate chassis and each one is separately fused and independently switched.

Relays are used throughout for switching of circuits and are actuated by the "transmit" switch on the front panel.

The front panel which is crackle gray aluminum, carries all engraved nomenclature enabling anyone familiar with ham gear to set it in operation without the use of operating instructions.

CONSTRUCTION

RF Section

When the power amplifier and the antenna coupling device was completed as per previous article in 73, it was housed on a separate chassis plate together with other components

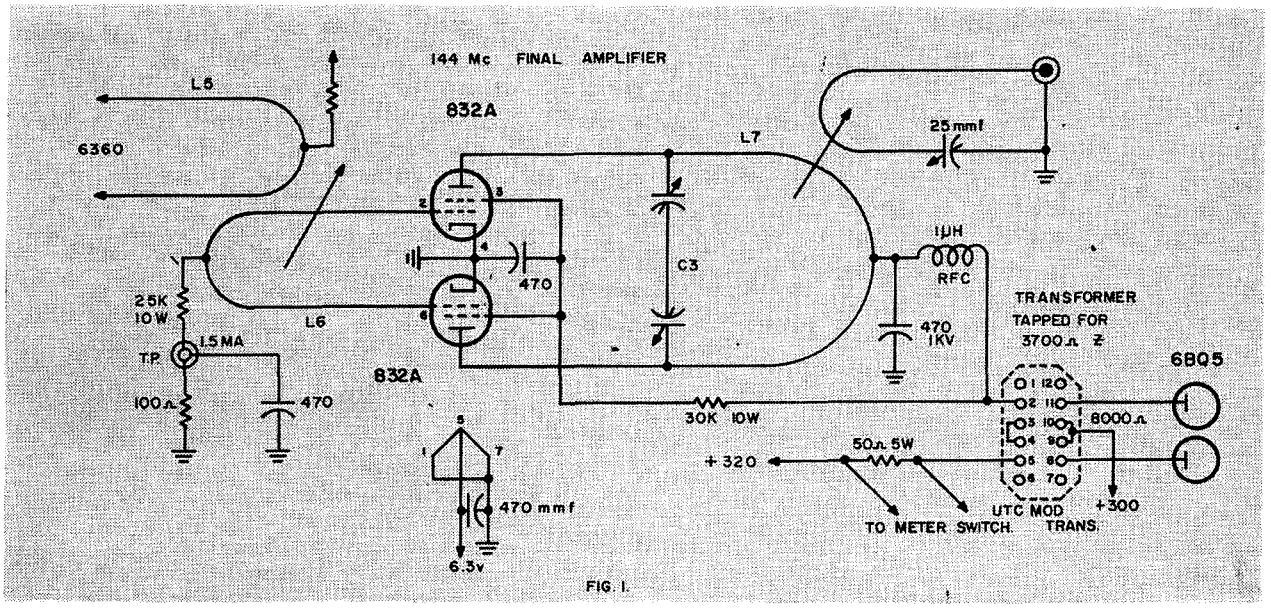


FIG. 1.

C3 Hammarlund MCD 35-SX (2 plates removed from each stator)

L6 1½" x 2¼" #10 hairpin shaped

L7 Aluminum Tank

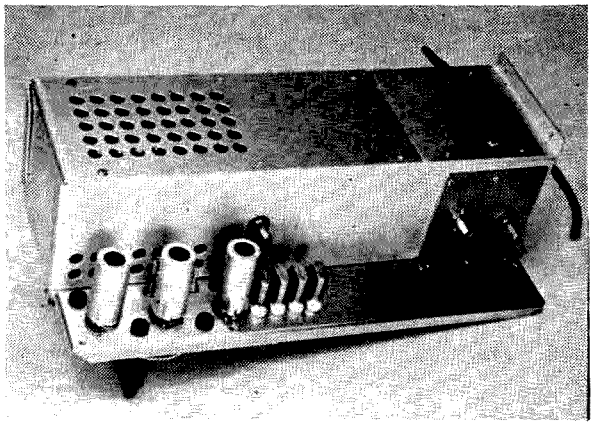


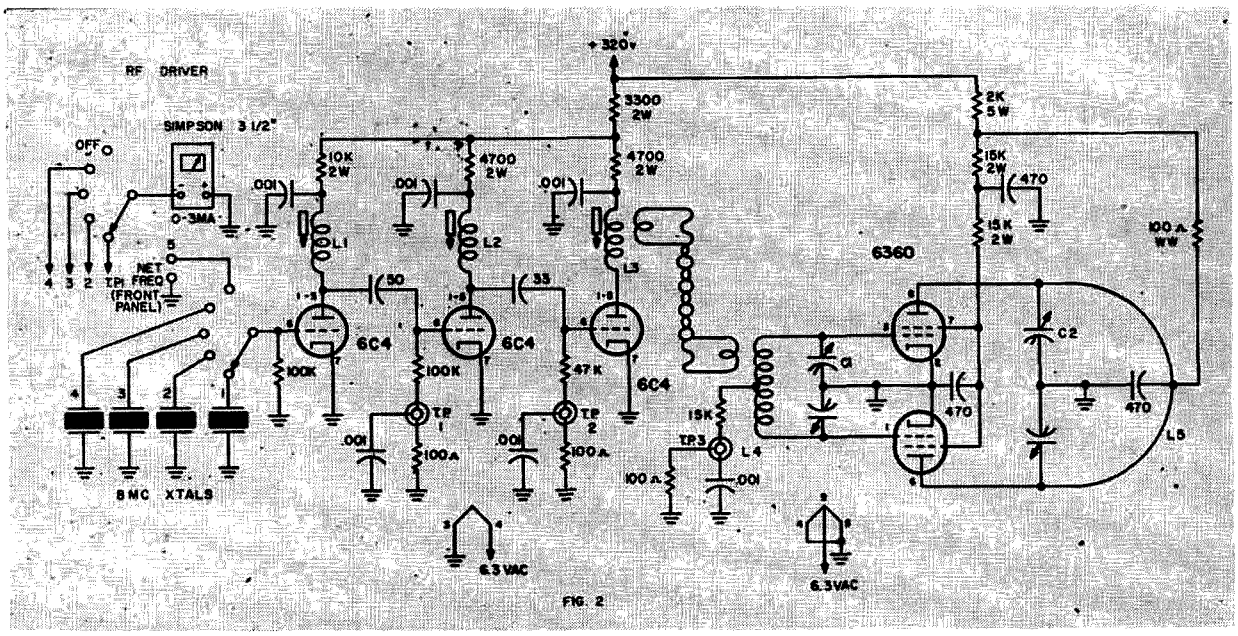
Photo showing the complete rf module.

comprising the entire rf section. The xtal oscillator using a 6C4 tube and the 8 mc fundamental crystals is tuned to 8 mc at its plate by L1. A 50 mmfd coupling capacitor drives the grid of the next stage which is also a 6C4. The plate of this triode is tuned to the third harmonic by L2 and operates at 24 mc. From the plate of this tripler a 33 mmfd is used to couple the energy to the grid of the following 6C4. The plate coil L3 of this triode is tuned to the second harmonic of the incoming signal making it resonant at 48 mc. In order to get balanced drive to the final amplifier a push pull arrangement was used and a 6360 dual tetrode which operates as a tripler and drives the grids of the final amplifier at 144 mc was selected. The grids of this tube are driven at 48 mc by link coupling of the preceding stage as seen on the schematic. Plate and screen voltages to the 6360 are low, allowing it to just loaf along. As seen in the bottom view, the hair-pin tank circuit with its Hammarlund HFD 15X split stator capacitor is mounted over the 832A socket to tune the plate circuit of the 6360 trippler. Parallel to this tank a similar loop and of the same dimension is soldered to the grid posts of the 832A socket and adjusted for maximum grid drive of the final. Sufficient drive is obtained in this manner, eliminating an extra control and a possibility of tuning the final grid to some odd harmonic.

Since the power amplifier is operated below the CCS tube rating, protective cathode bias was dispensed with for the sake of better parts arrangement and better by-passing. Accidental loss of grid drive by tube failure cannot damage the final due to the relatively low voltages and adequate metering of the circuits to detect such faults. Off resonance loss of drive can only result by rotating the dials beyond the engraved portion of the drive capacitor. In either case, damage to the transmitter can only result from prolonged unorthodox practice.

The wide-vue 3½" Simpson meter to the left, is used to meter all grid circuits and is a 0 to 3 ma full scale. With one to one and a half mills of grid current to the final amplifier, the negative grid voltage developed is up to 37 volts which is sufficient to drive the 832 at the figured input with good efficiency.

Coils for the oscillator and the multiplier stages are ½" O. D. slug tuned ceramic coil



L1 30T #26E close wound (8mc) J. W. Miller (ceramic form) #43A000CBI

L2 17T #26 close wound (24mc) J. W. Miller #43000CBI form

L3 11T #20 close wound last 4T spaced to fill form and two turn link on cold side J. W. Miller form #43000CBI (48 mc)

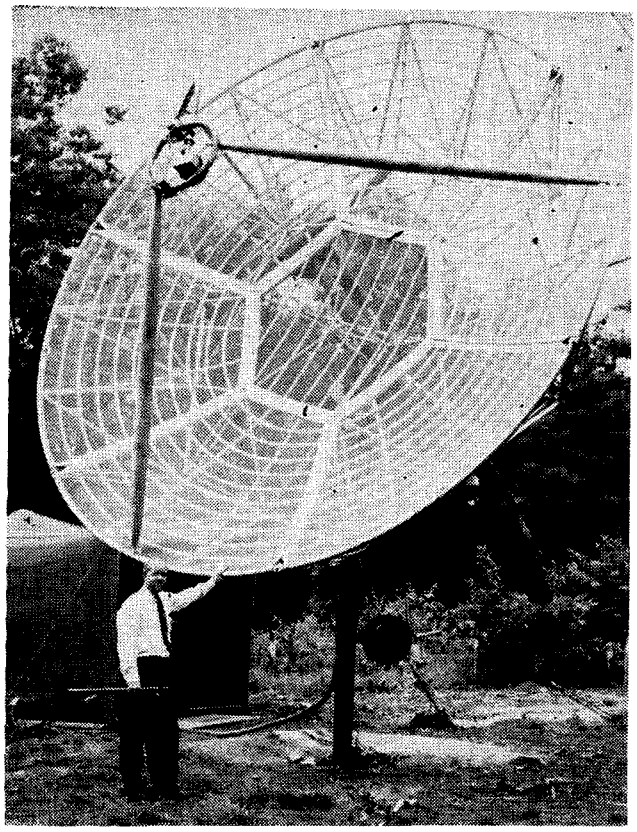
L4 13T #20 spaced to fill form (slug removed) tapped at center, and 2T link form #43000CBI (48 mc)

L5 #10 bare copper 2½" long (144mc)

C1 Johnson 11 MB 11 10.8 mmfd

C2 Hammarlund HFD 15X two plates removed from each rotor

All rf by-pass capacitors are RMC discaps



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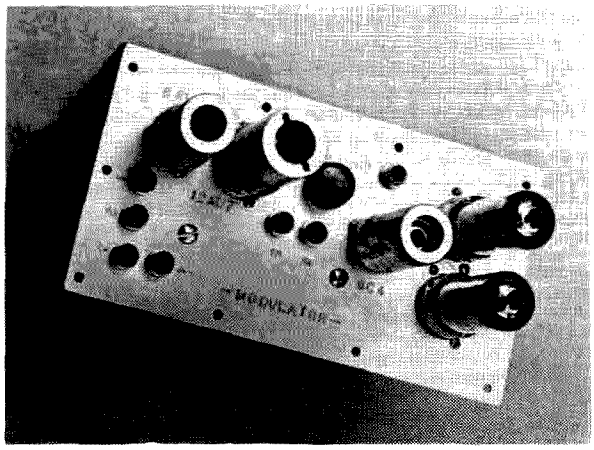


Photo showing the complete audio section jack 1 to 6 are for jumpers to by-pass the clipper if desired.

forms obtained from J. W. Miller Co. and carry a number of 43A000CB1. These coils are ruggedly built and adapt themselves for broad band rf circuits very nicely. In the design of these coils broad banding was considered to eliminate extra tuning controls and such was accomplished by making the coils resonant to the design frequency without the use of shunt tuning capacitors. This called for a few extra turns to build up the necessary inductance and with the use of a grid dipper this presented no problem.

Crystals as cheap as they are today, overruled the built in VFO for that extra stability, although provisions have been made to feed the VFO into the front panel xtal socket if so desired. The xtals selected for this transmitter have a differential of 100 kc and can be switched through the entire set of 5 during "on the air" operation without touching up the multiplier or driver stages.

Detailed description and parts lay out of the rf section seemed unnecessary since the photos and the schematics encompass such information.

RF Section Tuning

The best way to handle rf circuits is to work on one stage at a time and this calls for setting the crystal oscillator on frequency and making sure that it takes off without hesitation when power is applied to it. When all components are soldered to and around the 6C4 oscillator tube, check it for oscillation by connecting a 1 meg resistor to the grid and read the negative grid voltage with a VTVM or 20,000 ohm per volt meter at the 1 meg resistor and ground. Tune the slug in the plate coil L1 for the highest reading, then trigger the B+ several times to make sure that the oscillator kicks in every time. After the second stage which is the tripler and operating at 24 mc is wired in, the oscillator can be peaked by observing the grid current of this tripler stage. This should read approximately .6 ma at the test point. Same procedure can be carried out to the other stages by simply reading the grid current in the following stage. The 6360 plate circuit can be checked for 144 mc operation by listening to it on a receiver. Better assurance of the proper frequency can be obtained by a grid dipper or a simple wave meter.

The final amplifier stage should be close to design frequency if the dimensions of the tank circuit were carried out as per article. Optimizing the completed rf module may be undertaken for the assurance that maximum efficiency is derived from all stages, particularly the 832A final. The sugested way to bring the power where it will do the most good is by using a load resistor shown on the drawing and reading the voltage developed across this load.

Proceed as follows:

1. Use twenty 1000 ohm 2 watt composition resistors to make up a 50 ohm 40 watt non-

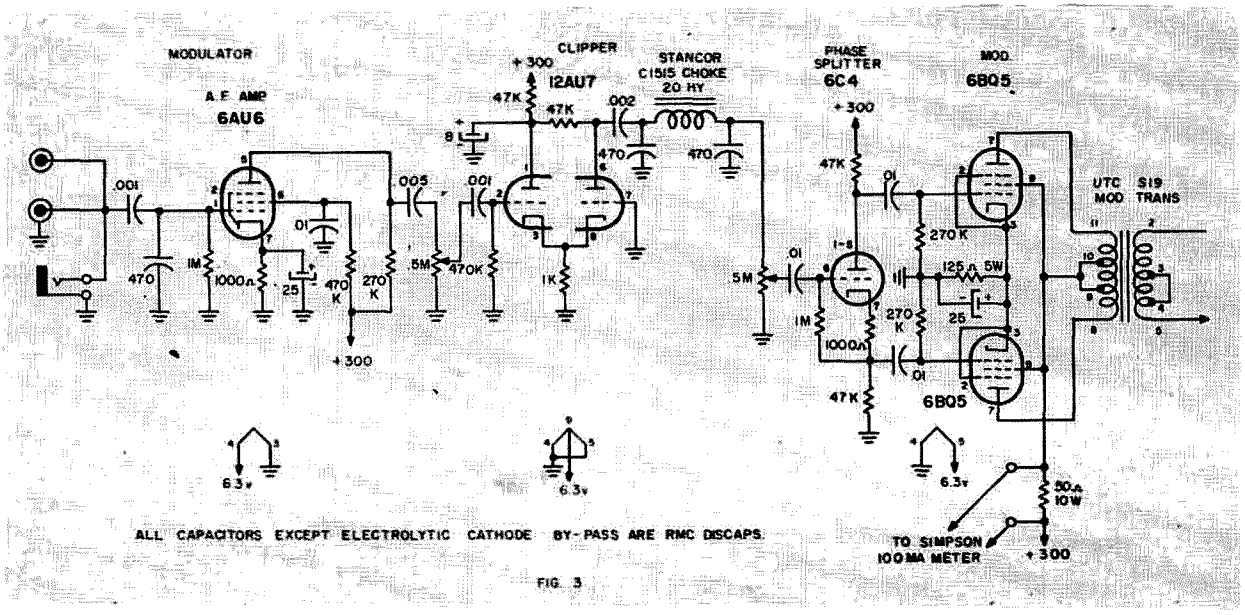
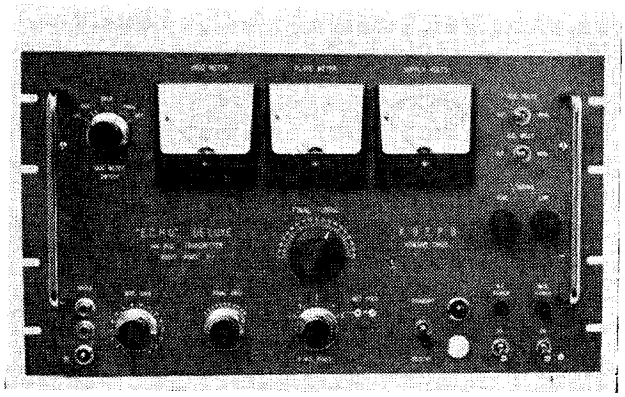


FIG. 3



The engraved front panel showing handles for protection of meters and dials. The final tuning knob is driven by a 2 to 1 gear ratio.

inductive load simulating the antenna. See detailed drawing.

2. Connect the dummy load to the output of the amplifier through a piece of coax.

3. Connect a 1N34 or similar diode in series with a voltmeter such as the Simpson 260 and read the dc voltage across the dummy load.

4. Calculate the power output by the equation $E^2 \div R$. Of course this is not the true power indication, but it is reasonably close and can be regarded as such in practical cases.

Once the set-up is made, adjustments in the grid drive, size and variations of the pick-up loop will tell you just what happens to your carrier. Therefore "on the air" information which in most cases is erroneous can be avoided.

Modulator

As can be seen in the photo, the 6BQ5 push pull modulator with its driver stages is made up as a complete module and fastened over a cut out in the main chassis which measures 17 x 7 x 3 and houses the completed rf unit. The first tube facing the front panel is a 6AU6 voltage amplifier running wide open. The next tube is a 12AU7 which is used as the speech clipper and following it is the 20 hy clipper filter choke which connects with the gain control in the grid of the 6C4 used as a phase splitter. This tube in turn drives the grids of the 6BQ5 modulator tubes. A UTC universal modulation transformer S19 is used and the primary side to the 6BQ5 is tapped to present a load impedance of 8000 ohms. The secondary of this transformer is tapped for 3700 ohms which is close to the final ampli-

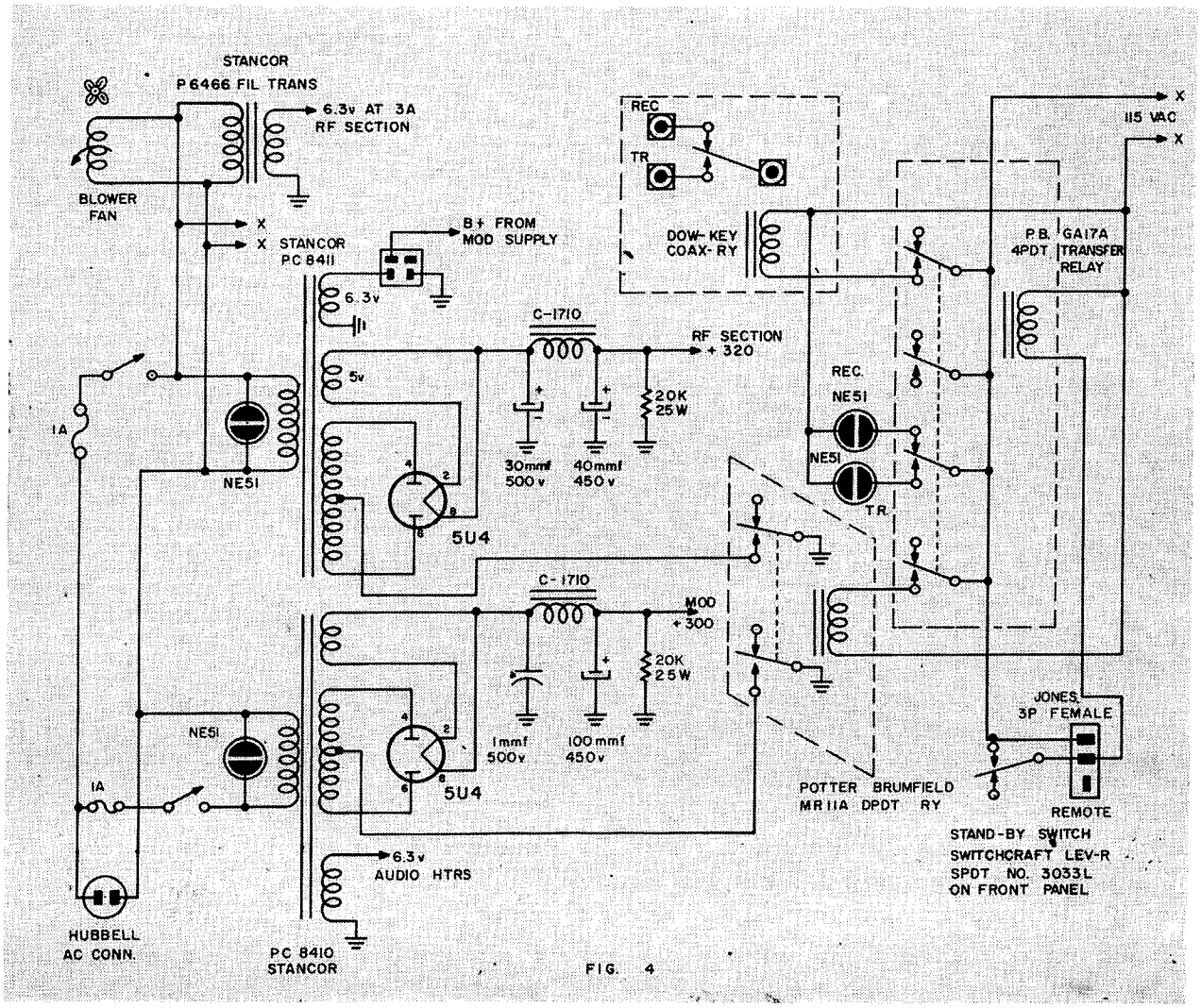


FIG. 4

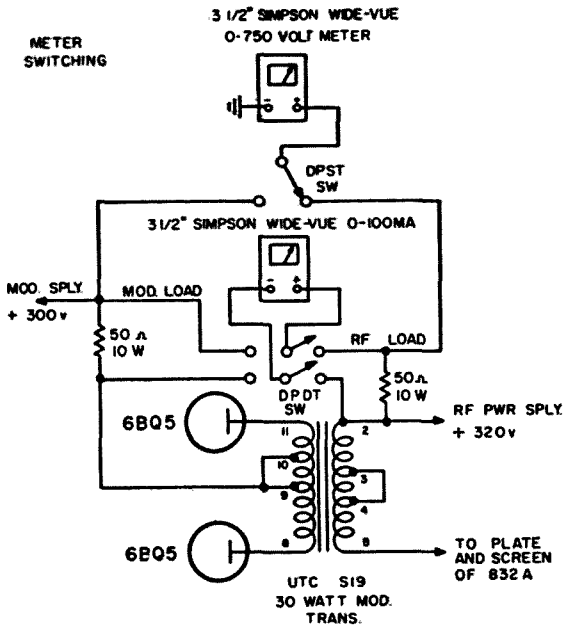


FIG. 5

fier load of 4100 ohms. Although the modulator is capable of only 17 watts of audio, a 30 watt transformer was used for that extra safety factor that is so frequently overlooked.

Coupling capacitors in the audio amplifier stages are purposely made small to pass only the high audio frequencies that seem to give that added punch to a well balanced carrier. The C-1515 Stancor choke seen in the bottom view is the clipper filter. It is mounted on 1 inch spacers to allow extra room for other components around it.

Testing the modulator before connecting the rf load to it can be accomplished by connecting an audio output transformer across the secondary of the modulation transformer using the same taps as the rf load, and listening on a speaker. Make sure that the audio transformer has an input impedance of approximately 4000 ohms to match the taps on the UTC S19 secondary. In this way adjustments can be made if necessary in the shack rather than on the air.

POWER SUPPLIES

Both of the power supplies are built on a standard 17 x 6 x 3 aluminum chassis and are of full wave design, using 5U4 rectifiers because of their ruggedness and ease of replacement. The supply used in the rf section produces 320 volts under full load, and is made up of Stancor PC8411 power transformer, Stancor C-1710 150 ma filter chokes and the electrolytic capacitors indicated on the schematic. Extra filament transformer was used for all heaters in the rf section to allow the power transformer to run cooler.

The supply used in the modulator section starts with a Stancor C-8410 power transformer, a C-1710 choke, and the filter capacitors. As noted on the schematic, a 1 mfd capacitor is used in the input to hold the dc voltage down to 300 volts. A 100 mfd electrolytic capacitor is used in the output of the pi section filter to eliminate all traces of 120 cycle ripple.

Values of the four filter capacitors in the two pi-section power supply filters should be in mfd., not mmf. as shown.

Each supply is separately fused and switched from the front panel. Above each switch is a neon pilot lite indicating that power is applied to the primary of the transformers. DC is obtained by grounding the center tap of each transformer through a double pole Potter Brumfield relay MR11A.

Two toggle switches are provided on the front panel just to the right of the meters to monitor the current and voltage of each supply. Trouble can immediately be spotted in either unit by unusual indication of the instruments.

Remote control receptacle is provided on the back of this chassis and wired in parallel with the transmit-receive switch on the front panel to allow one switch operation; either from the transmitter or the receiver.

SWITCHING

All switching pertaining to "on and off" the air mode is accomplished by relays as indicated on the drawings. This system requires only a simple toggle switch to apply power to the relays which carry the load through heavy plated contacts that can easily be reached for cleaning in case of need.

The Dow-key coaxial antenna relay is mounted on top of the power supply chassis and is coax connected to the final amplifier link through a ¾" hole in the top of the chassis as seen in the top photo. This relay

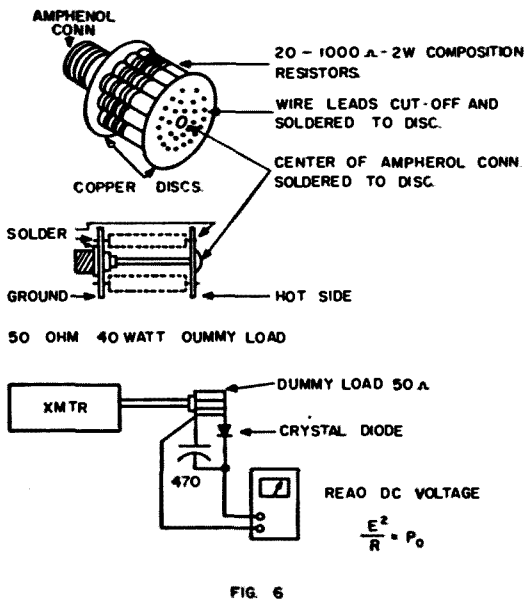


FIG. 6

is operated through a P & B GA17A transfer relay that also applies power to the pilot lites and the P & B MR11A. All long wires running to and from relays and pilot lites are color coded and laced for easier circuit tracing and neat appearance.

OPERATION

Under nominal operating conditions the power amplifier operates at a plate voltage of 320 volts and drawing 78 mills of combined plate and screen current. This conditions figures to an input power of 25 watts and a rf load impedance of 4100 ohms. At this power input to the amplifier, 28 volts rms was measured across the pure non-inductive dummy load previously mentioned, and power output calculated by the equation of $E^2 \div R$ figures to be 15.7 watts.

The calculated efficiency which is $(P^0 \div P_i) \times 100 = 15.7 \div 25 = 62.7\%$.

This is better than average power amplifier efficiency considering the operating frequency at which it was calculated, and comparative tests on the air have proved it.

My thanks to K9EPB for processing all photos. . . . W9DUT

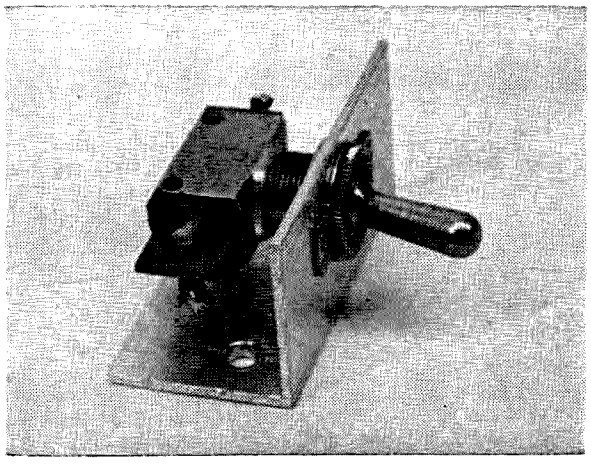
Bread Board Brackets

Building experimental circuits in bread board form first is a time and money saver. But mounting parts such as switches, jacks, and potentiometers usually involves complicated panel mounting provisions. Your hardware store has a ready-made solution to your woes: 1 inch aluminum angle stock, $\frac{1}{16}$ inch thick.

The angle stock (Reynolds Company) can be easily sawed off in short lengths, using any kind of saw. I found 2 inch lengths just right for most small parts, and 1 inch sufficient for single connectors.

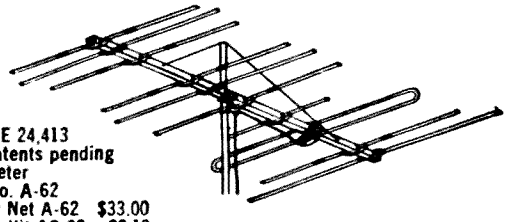
Drill two small mounting holes in one face of each bracket, and the component mounting hole in the other face. Plan the mounting hole locations so that you can mount or remove the bracket while the part is in place.

. . . Bentley



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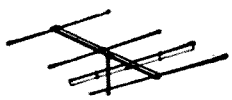
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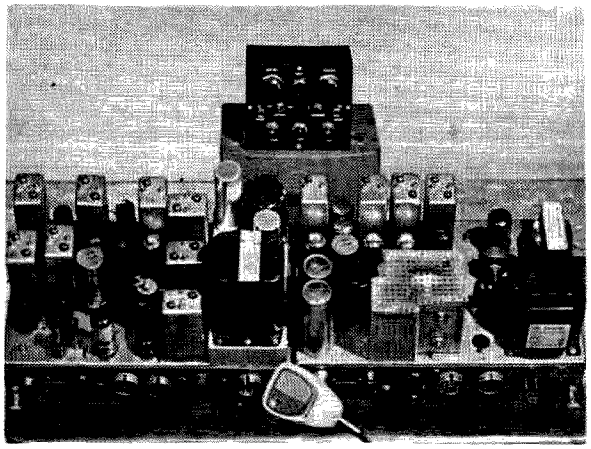
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Operating the "Friendly Frequency"

Lloyd Hanson W9YCB
Electrical Engineering Department
Tri-State College
Angola, Indiana

Photos by Gentry K9GLL

There are available through the various surplus outlets a large number of FM transmitter receiver combinations which may be readily and economically modified for operation on six and two meters. The challenge for



improved circuit operation and convenience is present in a degree seldom found on the "DC bands."

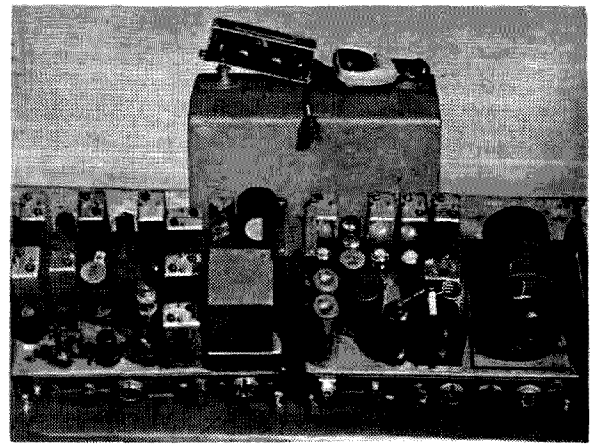
Typical of the equipment available at low cost is the AN/VRC-2 and the AN/VRC-2X. These units are crystal controlled wide band FM units (40F3) which before modification cover the frequency range of 30 to 40 megacycles.

These units when complete consist of a radio transmitter T-322, T-193, T-193A or a T-193B; a receiver R-435, R-237, R-237A or R-237B; control head, fuse box, loudspeaker, antenna and cables. The suffix units differ mainly in primary power source and voltage.

Complete information on these and similar units may be found in TM 11-668, "FM Transmitters and Receivers," available from GPO. TM 11-607 or TO 16-30VRC2-5 available from surplus outlets and "Motorola 25 to 44 mc Instruction Manual," Motorola part number S4P474783-0. These manuals will supply diagrams, theory and adjustment procedure.

Now that you have the inside facts on the equipment examine the photos for a typical mobile 12 volt version modified to operate on the "Friendly Frequency" of 52.525 mc and typical ac conversion which operates on 52.525 mc and 52.640 mc at the flip of a switch. It is possible to introduce another frequency of 52.775[1] mc for three channel operations all without retuning, just push the button. Nice, huh?

There are well over 250 mobile and base station units of this type on 52.525 mc within the United States. Interest is spreading rapidly



and groups are springing up from coast to coast and Hawaii. DX is common and will improve as more units are put into operation. For AREC and other types of emergency work there are few systems available which offer such low cost, high reliability and interference free communications.

Also there is a move afoot to register 52.525 as a national calling frequency with repeater stations and all. Twenty-four hours a day you will find help and companionship on "The Friendly Frequency" of 52.525 mc. Climb aboard for the best thing that has happened to amateur radio in many a year.

Remember FM is the Finer Medium.

. . . W9YCB

(1) 52.775 mc. was chosen as it represents the extreme frequency which can be used without retuning.

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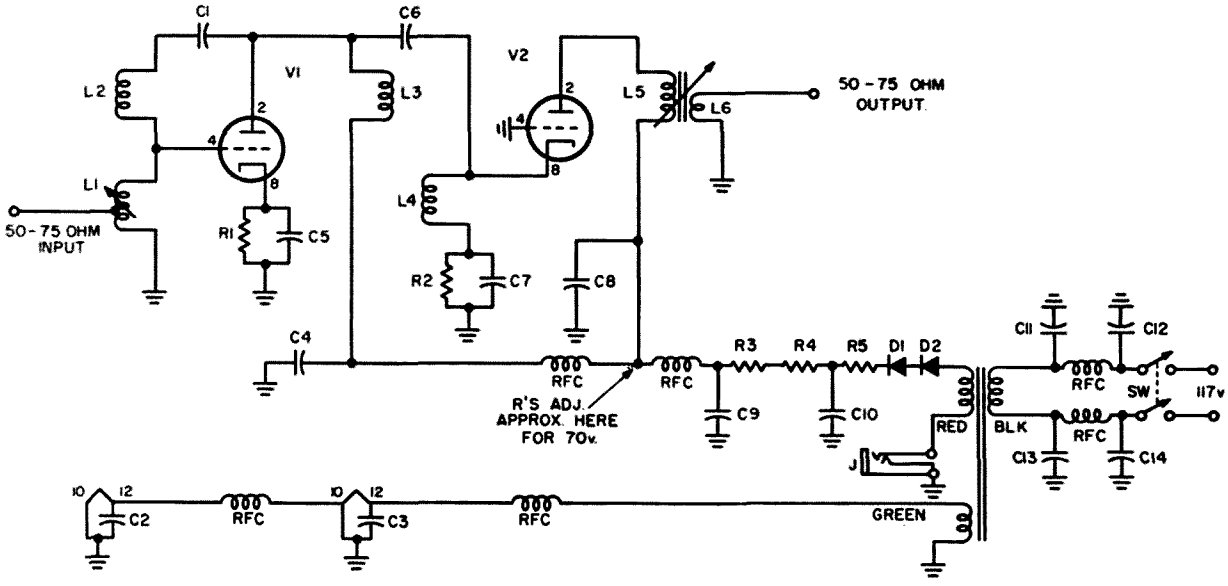
NUVISTORS have been around for a year now and enough has been written about them so they probably will soon be called Oldvistors. By way of encouragement to those few VHF'ers who haven't yet succumbed to the 6CW4, I thought I'd pass along the results of my bout with 'em.

The results are indeed good. Careful comparison tests between these Nuvistor preamps and a set of 417A converters using a 5722 noise diode and a switchable 3 db pad result in only .25 db difference in favor of the 417A's. The six meter unit gives 2.25 db vs 2.0 db and the two meter unit 3.25 db vs 3 db. This ought to be enough to get you into action.

The pre-amps were built on 2"x4"x10" chassis. In the interests of simplicity of use I included a small power supply with each preamp. The whole works for each unit came in for under $12.00.

The use of two nuvistors in a cascode circuit makes for less critical neutralizing adjustments, better gain and a good noise figure.

Try them! . . . K9ARA



Two Meter Pre-amp

C1 thru C8, C11 thru C14—500 mmfd.

L1—8T #20, tapped 3½T up from ground end, turns spaced one turn on ¼" dia. slug tuned form.

L2—9T #24 on ¼" dia. insulated rod or air core.

L3—16T #24, 5/32" inside dia.

L4—Same as L3.

L5—8T #20 spaced one turn on ¼" dia. slug tuned form. Millen #19 Mix or CTC-20063D.

L6—1½T #20 insulated and wound in opposite direction around cold end of L5.

RFC—25T #28, 5/32" inside dia. or Ohmite Z-144.

Six Meter Pre-amp

C1 thru C8, C11 thru C14—.001 mfd.

L1—12T #28 enam. tapped 3T up from ground end on ¼" dia. slug tuned form.

L2—Ohmite Z-50 RF choke with 10T removed from one end.

L3—Ohmite Z-50 RF choke with 20T removed, 10 from each end.

L4—Same as L3.

L5—15T #28 enam. on ¼" dia. slug tuned form. Use high freq. core. Millen No. 19 Mix or CTC-20063D coded white.

L6—8½T #28 enam. wound in opposite direction around cold end of L5.

RFC—Ohmite Z-50 RF choke.

Same for both Pre-amps

R1, R2—56 ohms
R3, R4—1.8K, 2W
R5—47 ohms
J—Closed circuit phone jack for T-R switch.
D1-D2—Silicon Rectifier diodes, 400 PIV 500 ma. RCA 1N1763 or equiv.
T—125v 15 ma transformers, Stancor PS8415.
Socket—Cinch 133 65 01 001.

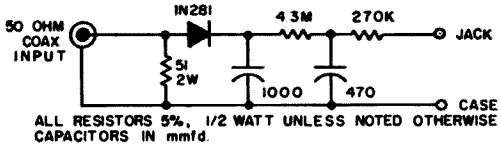
Accurate Milliwatt Level RF Power Measurements

David J. Bernays K4UWX
HAMBOARDS
Box 13158
Pine Castle, Florida

ACCURATE measurement of rf power in the milliwatt range is frequently a difficult task and one whose results may often be more a matter of opinion than measurement. With the advent of transistors and the resultant low power transceivers and transmitters developed using them the need to make such power measurements has increased. This problem arose recently at K4UWX during the design of a two meter transistor transmitter. A quick examination of the catalogs showed conclusively that commercial equipment designed for this job was priced completely out of reach! An inexpensive rf probe for the VTVM on the other hand had such lengthy leads and spread out internal circuitry as to be unreliable at even the lowest VHF frequencies.

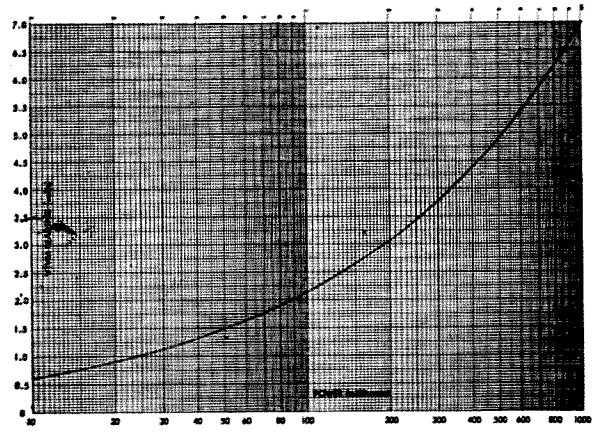
After much head scratching and several cans of beer, the solution finally appeared and ultimately took the form of the circuit shown below. The adapter, because of its compact design, gives accurate results at all frequencies from 160 to 1¼ meters. It may be modified, as noted further on, to extend its range to include transmitters up to 5 watts input. Best of all, the parts, even if purchased new, cost less than $5.00. This assumes, of course, that you have, or can beg, borrow or steal a VTVM! The graph, Fig. 3, is provided to read power directly in milliwatts.

A circuit description is as follows. The two watt, 51 ohm composition resistor provides an accurate 51 ohm load for the equipment under test. It is usable continuously up to power dissipations of one watt. This resistor is followed by an rf version of the familiar ac-dc power supply type half wave rectifier. The rectifier in this case is a gold bonded germanium diode,



type 1N281. The following filter is capacitor input and in operation charges up to one half the peak rf voltage applied across the load resistor. The 4.3 megohm and 270K resistors, combined with the 11 megohm impedence of a typical VTVM, form a voltage divider, so arranged that the VTVM will read a dc voltage equal to .707 times the voltage the .001 capacitor has across it. Net result—the VTVM reads rms rf voltage. One tenth of a volt should be added to the VTVM reading to take into account the drop across the diode.

The adapter is constructed on a 5 lug terminal strip inside a 3¼ x 2⅛ x 1⅝ Minibox. Fig. 2 shows the parts layout and lead dress. The screw which holds the terminal strip should extend an extra ¼ inch beyond the outside of the case to provide a convenient place to clip the VTVM common lead. All leads should be kept as short as possible. Care must be taken when installing the diode to be sure it is not damaged by excessive heat. This is true to a lesser extent of the resistors as changing their values will obviously throw the calibration of the adapter plus VTVM combination off.



The probe is made of a short section of RG-58U 50 ohm coaxial cable. An rf connector, in this case type BNC, is installed at one end. The other end is stripped clear of insulation, taking care not to cut the braid under it, for about four inches. The inner conductor is then carefully worked out through the side of the braid. After this is done, alligator clips are fastened to both leads approximately one inch from where the inner conductor is brought out. Insulators on the alligator clips prevent accidental short circuits. It is important that the distance from the point where the inner conductor is brought out of its braided jacket to the alligator clips be kept at a minimum since that section of the cable no longer represents 50 ohms. If the separated leads are excessive in length, serious errors can occur in the observed voltages.

The adapter is simple to operate and requires in addition only a VTVM. (A VOM won't work). Connect the adapter to the equipment being tested using standard coax hardware. If

this is not possible use the probe, with the inner conductor going to the "hot" rf point and the braided lead to ground. A .001 capacitor may be connected in series with the inner conductor to block dc if necessary. Plug the VTVM dc probe into the adapter jack and clip the common lead to the adapter case. Test. The VTVM should be set on an appropriate negative dc scale. (If it makes you happier to read positive voltages, reverse the diode!)

During actual operation the voltage drop across the diode must be added to any voltage reading to get an accurate rms rf voltage. In the case of the 1N281 this amounts to approximately .1 volt. This voltage drop also creates a small error in any power readings that may be made unless it is taken into account. The graph in Fig. 3 has been drawn for an adapter using a 1N281 diode. It may be used to read power directly in milliwatts.

For those who like to calculate things, this graph was derived as follows. The actual rms voltage is equal to the voltage observed on the VTVM plus .1. This, plus $E=IR$ and so on can be scrambled to yield $P = (V_{DC} + .1)\frac{(V_{DC} + 1)}{51}$

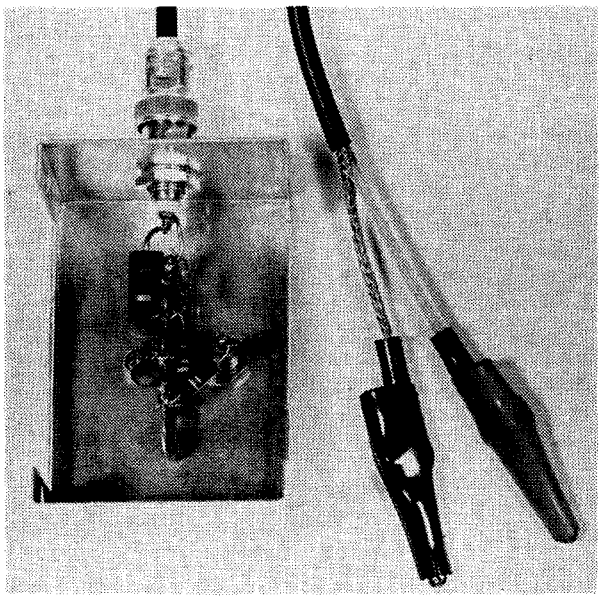
or, in milliwatts, $P = 20((V_{DC})^2 + .2V_{DC} + .01)$

where V_{dc} is the voltage read on the VTVM.

If a different type of high frequency diode than the gold banded germanium 1N281 is used the diode drop should be changed accordingly, about .13 volts for a regular germanium diode and .30 to .35 for silicon types. These drops are considerably less than those usually associated with such diodes. This is easily explained, however, as published values are normally measured with rated current flowing through the diode. Conduction in the microampere range actually begins at much lower voltages. Since the currents flowing in the diode portion of the adapter circuit are minute, to obtain accurate results it is necessary to use the diode voltage drop when conduction begins rather than that present with rated current flowing.

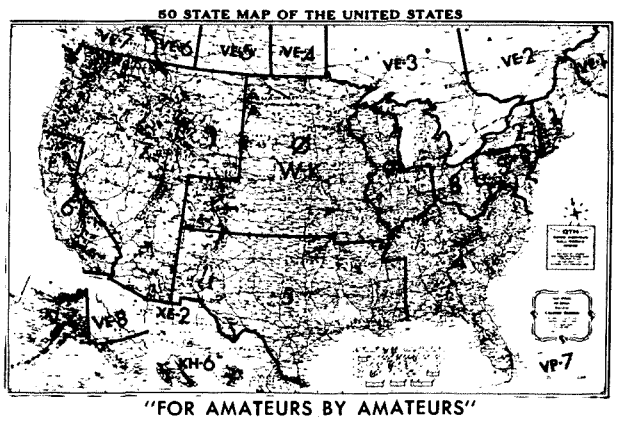
Power outputs greater than 1 watt can be measured if two parallel 100 ohm, 2 watt, composition resistors are substituted for the 51 ohm unit shown. Do not try to substitute wire wound resistors. They behave like inductors rather than resistors at rf frequencies! Power may then be calculated from $P=E^2/R$ using the VTVM reading as the diode drop contributes negligible error above one watt. This modification will permit the adapter to be used with transmitters running up to 5 watts input, which includes the Heath Tener, Sixer and Twoer as well as all CB rigs.

This unit can also be used where the device to be measured presents an impedance greater than 50 ohms if a series resistor is placed between the point of rf voltage to be measured



and the hot lead of the adapter probe. For instance, 200 ohms may be matched to the meter by inserting a 150 ohm series resistor. Power as shown with this adapter would then, of course, be one fourth that which was actually available. The voltage indicated would also be one fourth, minus the .1 volt diode drop, of the actual voltage available. This technique has proven handy when developing oscillator, doubler and driver stages.

In the few months since it was built this little adapter has become one of the indispensable pieces of test equipment at K4UWX. If your interests are similar, it will probably do the same in your shack. ...K4UWX



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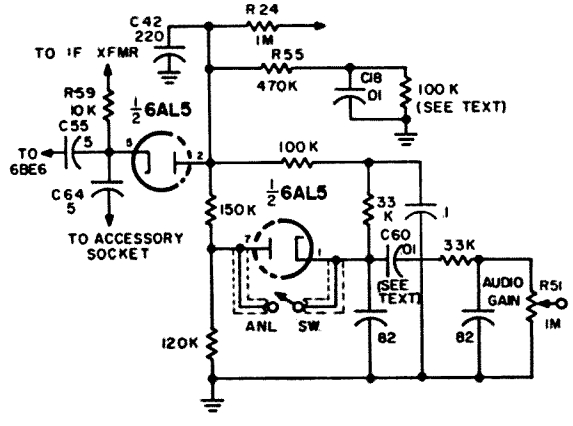
Why clip the noise off at the same level as the desired signal—*when you can yank it out by the roots?* Here's how . . . a

Bill Davidson W8IQN
79 Central Avenue
Dayton 6, Ohio

Rate-of-Change Noise Limiter

for the NC-300

ONE common complaint of NC300 owners is the difficulty of copying certain AM signals with the noise limiter on. Although the noise is substantially reduced, the distortion introduced greatly impairs legibility. In addition, the standard full wave series-diode limiter is far from being the most effective but is used by most equipment manufacturers due to its simplicity and low cost. This article describes the circuit modifications of an NC300



for incorporating a new type limiter which overcomes the limitations of most limiters.

As stated in April 1961 73* the "Rate-of-Change" Noise Limiter is considerably more effective, especially on short duration pulse noise (such as automobile ignition), and introduces no distortion.

The NC300 is easily converted because (1) the receiver already utilizes the one megohm volume control and 6AL5 tube required, (2) changes are necessary on only three pins of the 6AL5 tube socket, and (3) the off-on switch of the existing noise limiter can be utilized (if desired) without rewiring.

The only complication encountered in adapting the Rate-of-Change Limiter to the NC300 was caused by the S meter circuitry incorporated in the receiver. If this circuitry is not modified, the result is a loss of audio and unsatisfactory limiter action. Fortunately, no changes were required in the AVC circuit.

In the NC300 three changes were required in the April 73 circuit. It was noted that distortion on very strong signals resulting from detector overload occurred when load resistors of 27K ohms and 18K ohms were used. Upon substitution of 150K ohms and 120K ohms, two improvements were noted: (1) No distortion was present regardless of signal strength and (2) absolutely no loss of audio occurred with the limiter on. Limiter action remained very good, as before. In view of these improvements, the use of the ANL off-on switch is not mandatory, but it's nice to be able to check how effective the limiter actually is on various types of noise.

The second change from the April 73 circuit was the use of the existing 220 mmfd detector filter capacitor (C42) rather than the 20 mmfd specified. This caused no detectable change in limiter performance.

The third change is the use of a 33K resistor in place of the 330K in the April circuit. This results in maximum limiting action as evidenced on an oscilloscope. A slight decrease in audio will be noticed but the receiver still has plenty of gain to spare.

The following changes should be made at tube socket V6 (6AL5):

Pin 1 Disconnect one megohm resistor (R29); add 33K resistor and 82 mmfd capacitor.

Pin 2 Disconnect brown striped shielded lead (from ANL potentiometer); add 100K and 150K resistors.

Pins 3, 4, 5 and 6 No changes.

Pin 7 Disconnect 33K resistor (R43); add 120K resistor and connect 150K resistor from pin 2.

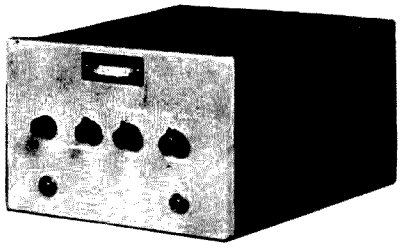
Connect .1 mfd capacitor as shown in schematic diagram. Complete wiring of components listed above as shown in schematic. Disconnect 27K resistor (R30) from junction of 33K (R43) and 470K (R55). Connect lead from this junction to junction of AVC line, one megohm resistor (R24) and 220 mmfd capacitor (C42).

Add a 100K resistor from V9 (12AT7) pin

*"A New Noise Limiter Circuit" by J. Kyle, K5JKX/6 April 1961 "73," Page 16.

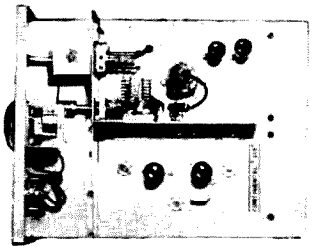
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7 to ground. The value of this resistor determines the sensitivity of the S meter and may be as low as 50 K or as high as two megohms depending upon personal preference. Since the NC300 has a reputation for being overly generous in its S meter readings, the 100K value results in more accurate S meter action. However, if generous readings are desired, a one megohm resistor may be substituted.

Now for the changes on the topside of the NC300: Disconnect either end of jumper wire from switch on ANL to ANL potentiometer. Disconnect shielded lead from lower end of .01 mfd capacitor (C60) on Mode Switch. Add 33K resistor from the shielded lead to lower end of C60.

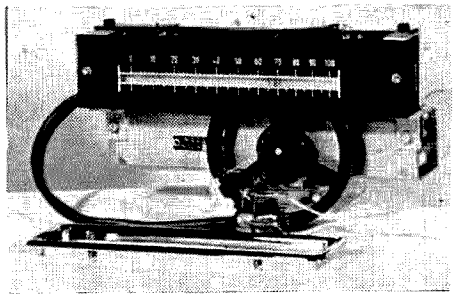
Add 82 mmfd capacitor from junction of shielded lead and 33K resistor to ground lug nearby on mode switch.

That should complete it. Double check against the schematic to be sure no errors have been made.

K4ZAJ reports that this same circuit has been incorporated into his SX100 with excellent results. We both agree that for the short time required to accomplish the receiver modification, the benefits of improved limiter action without distortion are indeed worthwhile. Many thanks to Jim Kyle, K5JKX/6 for bringing the Rate-of-Change Limiter to our attention!

... W8IQN

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This five tube unit consists of a complete two meter receiver foundation, requiring only the addition of a power supply and an audio stage to provide you with a fabulous receiver. Using only 200 volts DC at 38 ma. and 6.3 volts at 2 amperes for the filaments. Sensitivity is better than one microvolt for full output with a bandwidth of 20 kc. All tubes are included, and it is fully wired, not a kit, but rather a working unit ready to install in your cabinet. Postpaid $59.95

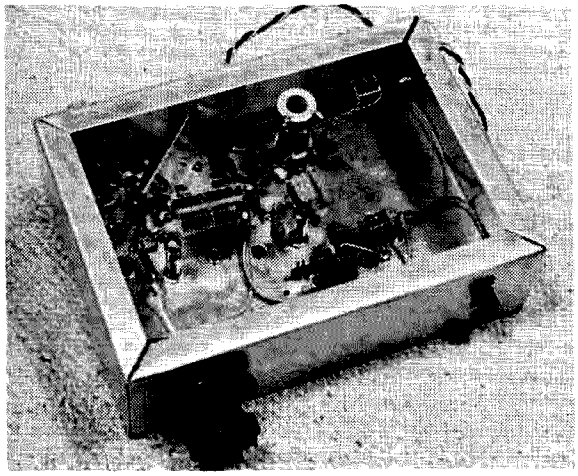
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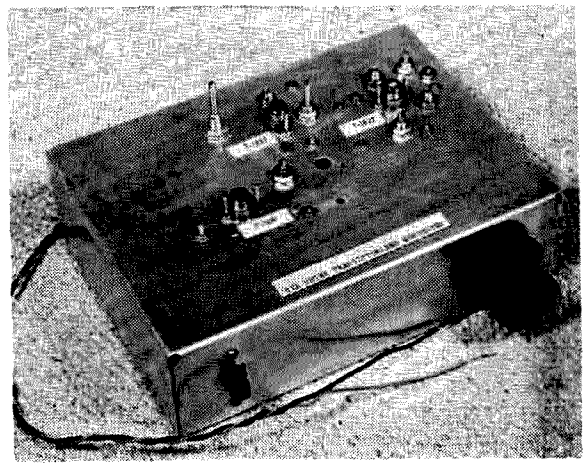
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Transistorized C.C. Converter for Six

John Specialny W3HIX
Philco Corp.
Lansdale, Penna.





THE article describes a six meter converter using three Philco MADT VHF transistors. It operates at a supply voltage of 12 volts and works into a communications receiver capable of tuning the 7 to 11 mc frequency range.

Circuit Description

A Philco T1832 transistor is employed in the neutralized rf amplifier stage. It operates as a common emitter stage with the incoming signal being applied to the base through the input tuning network consisting of coil L_1 and shunt capacitor C_2. It works with either a 50 or 70 ohm antenna system. The output utilizes a double tuned circuit made up of coils L_2 and L_3. Capactors C_6 and C_8 tune the coils to the desired frequency. Neutralization is provided bp capacitors C_7 and C_4. The tuned circuits are sufficiently broadband so that they can be fixed tuned.

Manual forward gain control is used to reduce the gain on strong signals. This method of rf gain control is accomplished in the following manner. As the collector current is increased, the voltage between the collector and emitter drops due to the series resistors R_4 and R_5, hence, the gain of the stage drops. The Micro Alloy Diffused-Base type of transistor is well suited for this type of gain control and provides much better overload performance than the conventional reverse gain control method. If gain control R_2 provides maximum stage gain when set fully clockwise. By varying the gain control counter clockwise, the value of collector current increases causing the

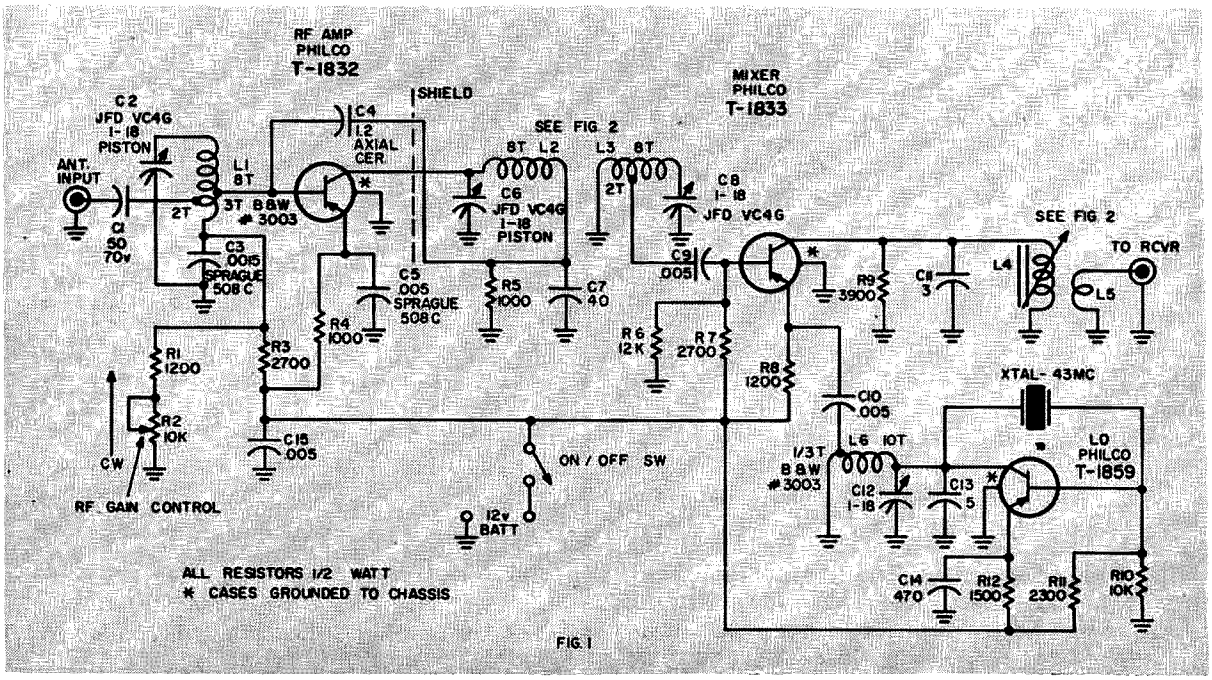


FIG. 1

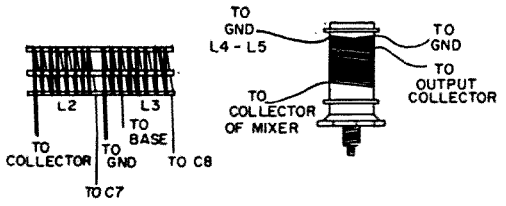


FIG. 2

L2-L3—Made from a single section of B & W Miniductor No. 3003, ½" dia. 16 turns per in. The coil is cut at 8½ turns and both leads are then unwound a half turn in both directions and are used to connect the cold ends of L2 & L3 to the proper points.
L4—Closewound No. 30 Nyclad copper wire on a ½" dia. form to occupy a winding length of ⅛". L5—15 turns No. 28 Nyclad copper wire closewound over cold end of L4. Form: Cambion LS7. Iron core: Cambion X2018D Red Dot.

gain to drop. Emitter resistor R_4 and the bias dividing resistor network consisting of R_1, R_2 and R_3 provide the necessary dc stabilization for the rf stage.

A 1833 is used as a mixer with the signal being applied to the base through a tap on the coil L_3. The output transformer T_1 tunes to about 8.5 mc and couples the output from the collector to the output connector. A loading resistor R_9 is placed across the primary winding L_4 of transformer T_1 to flatten the *if* response of the output circuit with some sacrifice of converter gain. Emitter resistor R_8 and bias dividing resistors R_6 and R_7 provide the dc stabilization for the mixer stage.

Emitter injection is obtained by tapping the emitter capacitor C_{10} on the oscillator tank coil L_6. An injection voltage of 0.15 to 0.25 v rms should be measured at the emitter terminals of the mixer. Emitter resistor R_{10} and bias dividing resistors R_{11} and R_{12} provide dc stabilization in the local oscillator stage. A 43 mc overtone crystal is used to control the frequency of the local oscillator. A Philco T1859 is used for the local oscillator.

Note: Figure 1 shows a value of 2300 ohms for R11. A value of 3300 ohms is preferable (preferable—that means the draftsman read my "3" as a "2").

The converter was constructed on a 7" x 5" x 2" aluminum chassis. The accompanying photographs show the placement of the circuit components. The top view of the chassis is shown in photograph A whereas the bottom view is shown in photograph B.

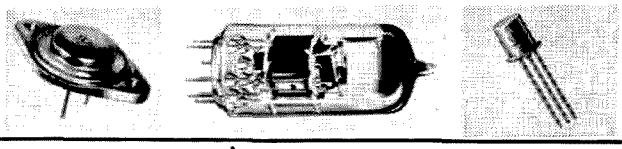
Performance

With the gain control set for maximum, an overall power gain of 45 db was obtained at 51.5 mc. The gain drops off to about 42.0 db at 50 and 53 mc. A noise figure of 4.1 db was measured using a noise diode generator. Table I indicates the value of collector current flowing in each of the stages. ... W3HIX

TABLE I

RF Amp	(max. gain)	Mixer
I_C	1.2 ma	1.0 ma
Lo		Total with divider current
1.7 ma		7.0 ma

TERRIFIC SAVINGS on . . .



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4-400A	35.95	33.95
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4X150A	12.95	11.95
5R4WGY	2.35	1.95
5U4WG	3.45	2.95
6C4W	3.45	2.95
6J6W	.89	.79
6L6WGB	3.45	2.99
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12AT7WA	1.85	1.59
807	1.49	1.29
829B	8.95	7.95
929	.99	.89
5654/6AK5W	1.29	1.09
5726/6AL5W	.89	.69
5749/6BA6W	1.29	1.05
5750/6BE6W	1.59	1.39
6146	3.95	3.65
6360	4.40	4.25

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5Y3GT	.55	.47
5U4G	.65	.59
6AG5	.75	.69
6AH6	1.24	1.19
6AK5	1.24	1.19
6AK6	.95	.89
6AL5	.59	.55
6AQ5	.69	.65
6AT6	.59	.55
6AU6	.69	.65
6BA6	.69	.65
6BE6	.69	.65
6C4	.65	.59
6H6	.99	.85
6J6	.95	.89
6N7	1.05	.99
6SH7	1.05	.99
6SJ7	1.05	.99
6SK7Y	1.05	.99
6SL7	1.05	.99
6SN7	.89	.79
6V6GT	.79	.69
6X4	.55	.49
12AT7	.95	.85
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12AX7	.82	.75
12SL7	.49	.39
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300ma	300piv	.39	.36
500ma	200piv	.39	.36
500ma	300piv	.49	.45
500ma	800piv	.99	.95
750ma	400piv	.59	.49
750ma	600piv	.89	.69
2amp	100piv	.59	.49
2amp	200piv	.79	.65
2amp	400piv	.99	.79
2amp	600piv	1.69	1.39
15amp	100piv	2.49	1.99
15amp	200piv	2.99	2.59
15amp	400piv	3.99	3.39
50amp	25piv	2.99	2.59
50amp	50piv	4.50	3.59
50amp	100piv	6.00	5.00
50amp	200piv	7.50	6.00
PNP-2N155etc		.79	.59
PNP-CK772etc		.59	.49
NPN-GT222etc		.69	.55

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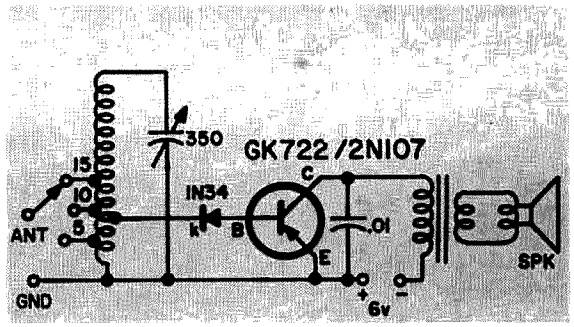
imple Tuner for Long Waves

W. G. Eslick KøVQY

THE growing use of ham-band-only receivers, while it makes for better ham communications, is depriving more and more chaps from the fun of tuning other frequency bands and hearing some of the interesting things going on there. One badly neglected band is the 200-550 meter band. Though most stations have moved up into the shorter wavelengths down through the years, and many right up into the VHF's, there are still a few stations operating in this old band. Here is a simple tuner which will let you listen in to these remnants of another age.

You can build this tuner in just amout any small box you may happen to have around. I installed it in an old antenna rotator control box, using the dial space for a small speaker. You'll need an antenna . . . about 20 feet did fine for me. You don't have to worry much about lead lengths at these low frequencies. I didn't even put in a volume control, depending upon detuning the stations for this. Simple as this is, it produces enough volume to be heard all over the basement.

I put in four flashlight batteries back in November and they're still going strong, running day and night since I didn't put in an on-off switch. This unit takes so little current that even old tired batteries will give several months operation. You may want to



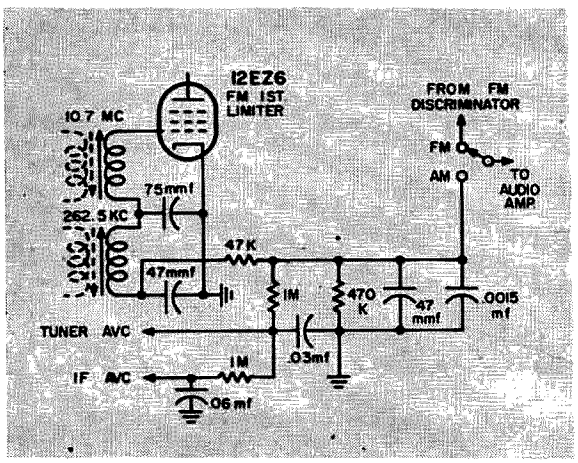
increase the voltage to 12 volts for weaker stations. Six volts is fine for nearer and gives less distortion.

The parts can be juggled to match your junk box. Any diode will do just fine. If you use an NPN transistor then reverse the battery. A 50L6 output transformer is better than one for a 6V6 or 3Q5 since it matches the transistor better. Tap the coil for loudest signals with your antenna. The coil consists of 80 turns of #22 or #24 wire closewound on a 2" form.

Perhaps, if enough of you start listening to this band, we can get 73 to publish a listing of the stations still operating there. I hope you'll get as much enjoyment as I have out of tuning this relic of the early days of radio communications. . . . KøVQY

More of FM to AM

The original short article[1] on the use of grid rectification in an FM receiver limiter for AM detection cited a fairly old item of military surplus equipment in which this technique was used. This method of AM detection has obvious advantages in surplus conversion work since few additional parts are required and the original FM reception capability is not impaired.



A more modern equipment using this technique is described in the 20th issue of "TUNG-SOL TIPS," published by Tung-Sol Electric Inc. The article, "Hybrid AM-FM Auto Receiver," by W. Guell, describes a unit designed by the Advanced Development Department of Tung-Sol's Radio and T.V. Tube Division. The purpose of the project was to demonstrate to the auto manufacturers the desirability and feasibility of such an automotive receiver. The receiver uses many common circuits which include use of the FM limiter as the AM detector.

Figure 1 shows a simplified and redrawn schematic of the AM detector. This ciruit is more versatile than the one described in the original article and provides AM detection, along with *if* and rf stage AVC voltage, from the first limiter grid. This technique is of great value in surplus conversion work and should be considered in the design of any dual-mode receiver because of the inherent simplicity and economy. . . . W4WKM

[1]"FM to AM," W4WKM, April, 1962 73 MAGAZINE.



a KW SWR/Power Meter

James G. Lee W6VAT
Box 45621
Los Angeles 45, California

WITH the declining sunspots, usage of the lower frequency bands is definitely increasing. The resulting increased QRM is helpful to no one and only efficient equipment and operating procedures will result in a maximum number of QSO's. The SWR/PWR meter described here won't make you a better operator, but it can help you be sure that you are delivering the most rf to your antenna from your rig. Fig. 1 shows a front view of the meter.

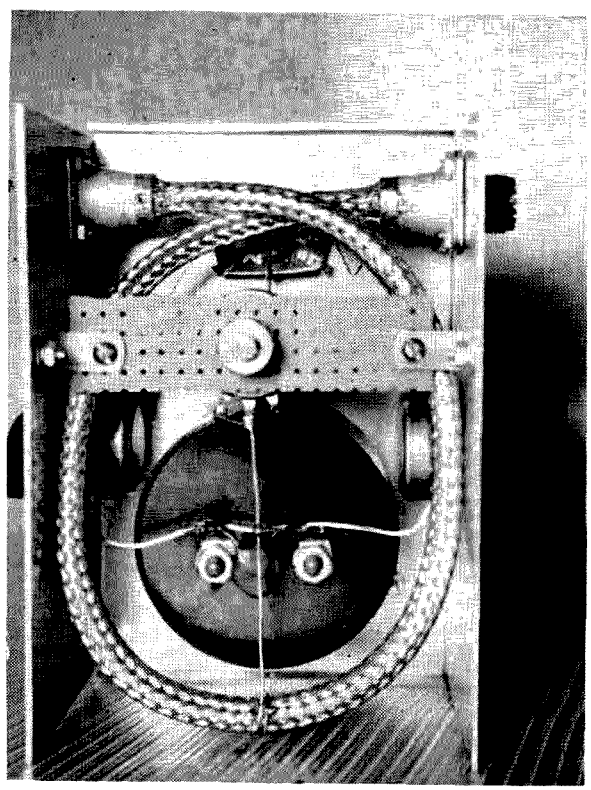
The basic circuit is a directional coupler switched to sample either forward or reverse voltage and a voltmeter to read this voltage.

This type of coupler has an output proportional to length, power, and frequency. The longer it is, the more output it gives. Since it puts a small impedance "bump" in the line, the length of the coupler should be limited to not over 1/20 wavelength at the highest frequency, or it may begin to contribute noticeably to the SWR itself. For a given power, if the frequency of the rf flowing through the coupler is reduced, the maximum coupler output is reduced. This means that you can get full scale readings on 10 M with a lot less power than on 80 M. The meter described here gives half scale deflection on 40 M, at maximum sensitivity, with about 350 watts of forward power. If your rig is a KW this meter will fill the requirements for SWR/PWR measurements nicely. It can be left in the line at all times to monitor SWR or Power delivered to the antenna or other load. If desired, a Barker and Williamson type 551A coaxial switch can be used to insert the meter in the line for test purposes and then switch it out during operating periods.

Construction

The unit is built in a gray hammertone LMB type 141 box. The dimensions of this box are 3" x 4" x 6". Fig. 2 shows the parts placement and should answer any questions concerning layout.

The coax directional coupler is made from a 14" length of RG-8/U. The outer covering is slit lengthwise with a knife and peeled off. Take care here not to cut into the woven braid. The woven braid is then bunched toward the center to loosen it. Next, a length of #22 enameled wire is passed through the braid at about 2¼" from one end and run under the braid next to the inner insulation. It is brought out at the other end, again 2¼" from the end of the shield braid. When this is done, smooth the braid back to its original position carefully to avoid scratching the enamel on the #22 wire. The #22 enameled wire should lay as straight as possible under the braid. It should have no slack nor should it twist around the inner insulation to any



great degree. The ends of the shield braid are trimmed back far enough to be soldered to Amphenol 83-1H hoods. The inner insulation is trimmed off so as to expose about 3/16" of the inner conductor. The inner conductors are then soldered to Amphenol 83-1R female type chassis mount coax connectors. The coupler may now be set aside and the rest of the meter constructed.

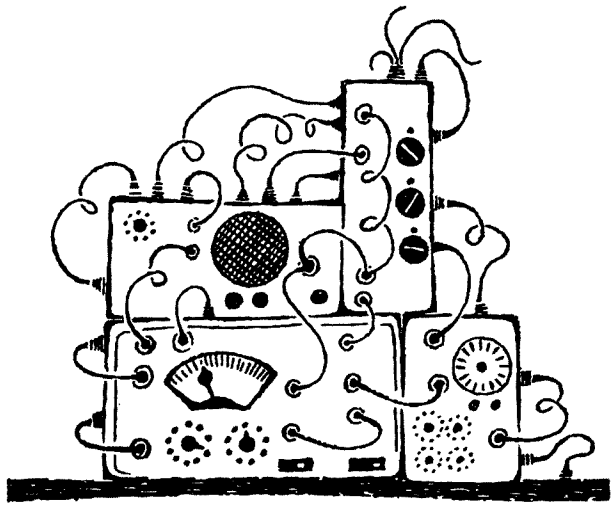
Potentiometer R_1 is mounted on 1/16" x 1" x 4" piece of bakelite and positioned approximately in the center of the box to minimize capacity to ground. The metal rear cover is removed from the pot for the same reason. The pot ground lead is to the center of the coax and is wire in last. The diode D_1 should be protected from damage by heat when soldering it in the circuit. Long nose pliers gripping the leads near the body of the diode are satisfactory. The directional coupler is the last item soldered in place. As can be seen in the photos—the coax connectors are mounted from the inside of the box. When the #22 enameled leads are soldered to S_1 they should be the same length, and again, take care not to scratch the enamel or a short circuit may occur and you'll have to do it all over again.

Calibration

There are any number of ways to calibrate the SWR/PWR meter, but the way most hams will use is their own rig and a suitable dummy load. Though very limited in power, a 2 watt 50 ohm resistor such as made by Ohmite, IRC and others, mounted inside an Amphenol 83-1SP male coax plug makes a very good dummy load. Although not completely non-inductive, this dummy load is far superior to such real unknowns as light bulbs, electric iron heating elements, etc. This particular load is 50 ohms shunted by 6 mmfd over the range of 3-30 mc. It is a good dummy load—though a low power one.

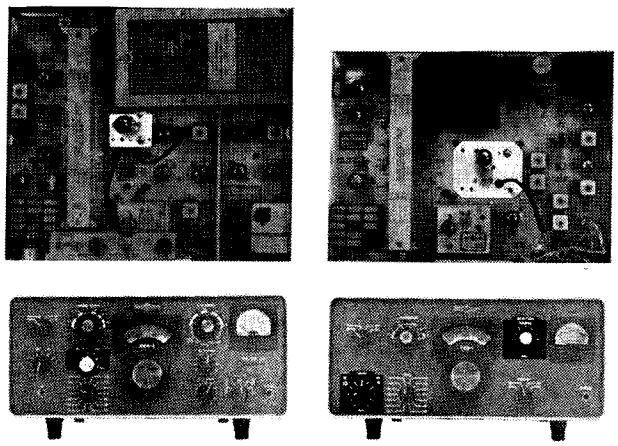
With the back cover off, attach the dummy load to J_1, the load jack. Set R_1, the Sensitivity Control, to maximum and S_1 to FORWARD. Next apply power by hooking your rig (or other rf source) to J_1, the transmitter jack. Make sure that the rf applied is 28-30 mc, or, the highest frequency you operate in the 3-30 mc region. This meter is sensitive to frequency. Stray capacities and other unbalances will have their greatest effect at the highest frequencies. In any event, calibrate the unit on the highest frequency your rig will tune in the 3-30 mc region. With power applied, set R_2 so the meter reading is at least half scale and switch S_1 to REVERSE. This will result in a lower meter reading. R_1 should then be adjusted for a minimum reading on the meter. Using the suggested load, you will not get a complete null, but the null should not be much more than 50 ua for half scale deflection in the FORWARD position on S_1. Don't put too much power into the dummy

WATERS



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load since excessive dissipation can ruin it and change its characteristics greatly. If you have a higher power dummy load whose characteristics you know accurately, by all means use it, but remember a light bulb is not a good load. Once nulled, lock the nut on R_1 taking care not to disturb the setting. Replace the back cover and using the dummy load, recheck the null to make certain that it has not shifted.

Using The Meter

To make SWR measurements you need only insert it in the line and set S_1 to FORWARD and S_2 to SWR. Adjust the sensitivity control for at least a half scale reading. Then switch S_1 to REVERSE and read the value. SWR is then calculated by the following:

$$SWR = \frac{I_{fwd} + I_{rev}}{I_{fwd} - I_{rev}}$$

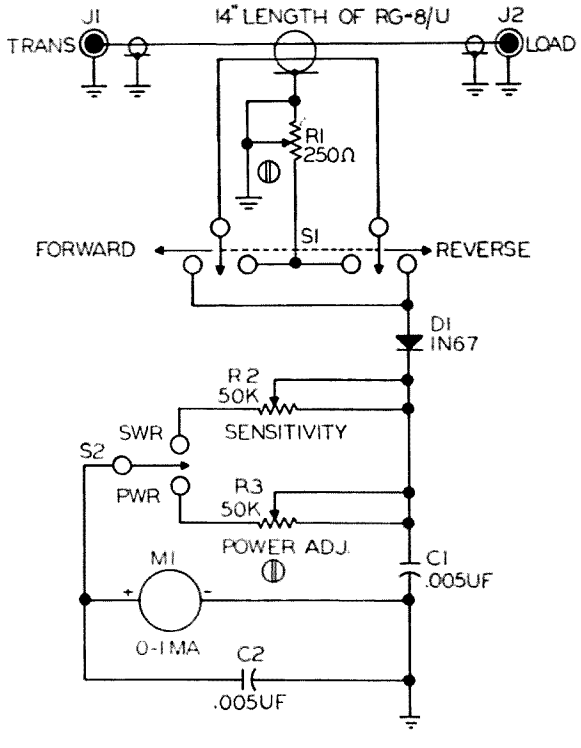
For example:

let $I_{fwd} = 500$ ua and $I_{rev} = 50$ ua, then

$$SWR = \frac{500 + 50}{500 - 50} = \frac{550}{450} = 1.22:1$$

The meter is useful for tune-up purposes where exact SWR is not needed. Just keep the FORWARD reading at a constant value and tune for minimum REVERSE readings. The exact SWR can be calculated when you have found the lowest REVERSE position.

The POWER position may appear to be essentially the same as the SWR position and it is. When measuring power into a load of known fixed value you only need to know the voltage across (or the current through) the load. The POWER position on S_2 is used with S_1 set to FORWARD. R_3 is merely set to a scale reading that is convenient for all bands if only a relative reading is used. If a good 50 ohm high power dummy load is available, you may make accurate calibrations by using a VTVM plus high frequency detector probe and measuring the actual voltage across the load. Just put a T-connector on the load jack J_1. Put the dummy load on one arm of the "T" and read the voltage at the other arm. 200 volts across a pure resistive load of 50 ohms is equal to 800 watts of power. If your rig delivers a key down 800 watts to a load then you could set R_3 at 0.8 ma on the scale, etc. The scale will not be precisely linear, particularly at low powers, but if enough resistance is used at R_3 the effects should be minimum. Since the coupler voltage is frequency sensitive one setting of R_3 will not hold for all bands. If desired, R_3 could be replaced with a switch and a number of selected resistors (one for each band). This would keep the scale factor constant between bands. This could be done for R_3 as well, but complicates an otherwise simple device



Operation

Once calibrated, the meter is very simple to use. Just hook it in the line at some convenient point and apply power. With S_1 set to FORWARD and S_2 set to SWR, adjust R_2 for at least a half scale reading. Switch S_1 to REVERSE and you will then be able to continuously monitor your reverse power. For power measurements, set S_1 to FORWARD and S_2 to PWR. Apply power and the meter will be monitoring your forward power continuously. R_3 is a screw driver adjusted pot. It can be set, and locked at a point which allows operation on all the bands you operate. The scale reading on each band will be different, but once set, these readings can be jotted down in your log book and any change quickly noted. This meter is also an excellent device for the antenna "tinkerer," or if you have coax coupling between stages in your rig it can be used to provide proper power transfer. Best of all, it is not expensive nor difficult to construct. Try one and you won't be without one again. . . . W6VAT

Parts List

R1—250 ohm pot, screwdriver adjustment w/locking nut—Ohmite CLU-2511.
R2—50K pot—Ohmite CB-5031.
R3—50K pot, screwdriver adjustment w/locking nut—Ohmite CLU-5031.
C1 & C2—.005 uf, 600 V disc ceramic.
D1—1N67 diode.
S1—DPDT rotary switch—Centralab 1462.
S2—SPDT slide switch.
J1 & J2—Amphenol 83-1R female chassis connectors with two 83-1H hoods.
M1—0-1 ma 3" meter—Triplett #321.
Chassis—3" x 4" x 6" LMB #141,, gray hammertone.

Marion Culver W9OFD
1841 South Calhoun Street
Griffith, Indiana

Selectivity Plus!

IT'S not original to observe that the amateur bands are more crowded than they were in the not-too-distant past (if I said how distant, I would be telling my age). For this reason the decision was made to try to do something about the condition, in regard to the receiving end of the station here. After a lot of thought, it seemed the mechanical filter bought the most selectivity per dollar.

These filters are compact and need no tedious adjustment. While they are not quite as rugged as a battleship, they can be expected to give a lifetime of service if they are given the same sort of handling as, say, a fine wristwatch. Their cost varies from a ten spot to three times that much, depending on which ad you read.

The mechanical filter is a compact unit which can be likened in many ways to an *if* transformer. Because it has little mechanically resonant discs within it, though, it has properties of selectivity which will separate stations on the crowded bands like a whole battery of Q-multipliers.

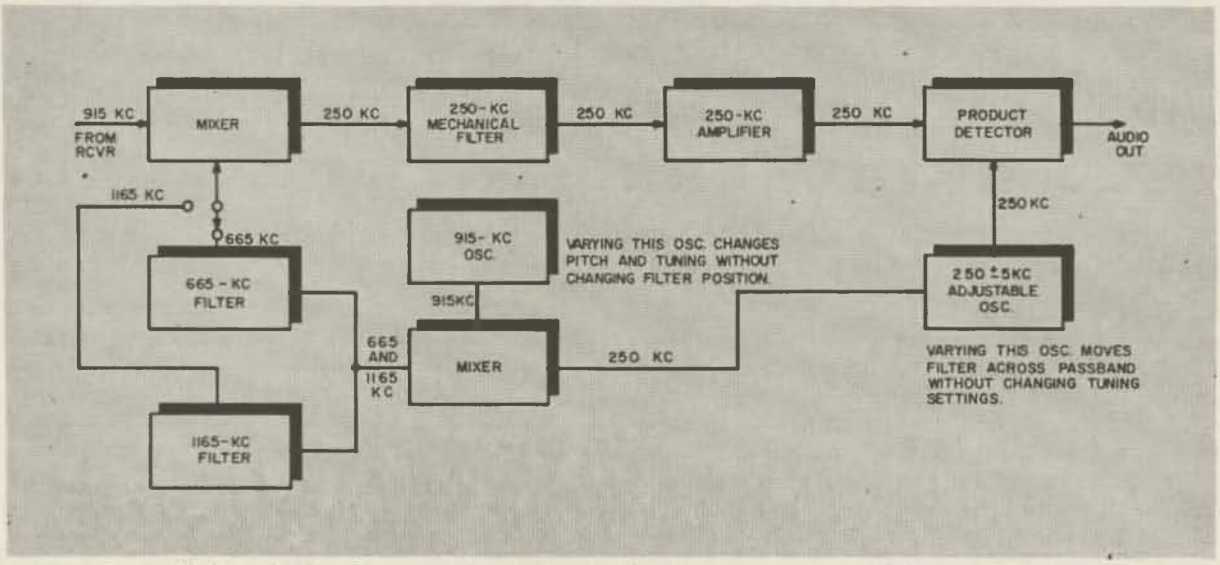
Indeed, this analogy is most applicable because whereas the Q of an *if* transformer can be increased to something in the vicinity of 5000 with the aid of positive feedback in the Q multiplier circuit, the Q of *each* of the six resonant discs in the mechanical filter is in the region of 5000 also, without benefit of any tricky regenerative circuits.

Electrically, there is no difference in the hook-up of the filter and of an *if* transformer. The filter can be said to have a primary and a secondary winding, each of which has to be brought into resonance with a small trimmer, just like an *if* transformer. The difference is that in the case of the *if* can, the *if* energy in the primary is inductively coupled to the secondary, and in the mechanical filter there are six little resonant discs between the two windings.

The primary drives one disc headphone style. It, in turn, drives the next one mechanically, and so on down to the end of the string. This last disc has a special coupling to the secondary coil. The filters are symmetrical and thus can be turned end for end without altering the characteristic.

While a mechanical filter can be used to merely replace an *if* transformer[1], in many cases realizing selectivity such as the operator has never experienced, the nearly ideal selectivity characteristic of one of these filters makes possible design of a much more exotic system.

In the case here, a filter was obtained which had a bandpass of 3.2 kc at a carrier design frequency of 250 kc. The official description of the unit is an "upper sideband 250 kc" filter. An incoming carrier in the *if* strip is tuned to fall on the lower-frequency slope of the filter and is about 25 db down in response. Some 200 cycles higher, the filter rises to its maximum response. This response continues unchanged to a frequency of approximately 253.2 kc. With the BFO operating at 250 kc and an AM station tuned to zero beat, only the upper 3.2 kc of his signal will be received, and



[1]See "Take Your Pick," our technical article in the April '61 issue for a usable circuit—editor.

this will be received in exalted-carrier fashion. The response on the low-frequency side of 250 kc is down 60 to 80 db because of the phenomenal selectivity characteristic. In the receiver built here, in daily use for the past two years, no audio image has been strong enough to be detected even under the most ideal conditions.

To put it in figures, the response of the lower side of this filter falls 60 db in half a kilocycle, while the upper side falls the same 60 db but takes a full kc to do it. Thus, the response of the flat top is 3200 cycles wide—but the response 60-db down (limit of audibility for most people) is still less than 5 kc, instead of the 12 to 20 kc to be found in many receivers. Also, you can see that for best sideband rejection, only the lower side of the filter should be tuned to a carrier.

When one becomes accustomed to using a receiver with this characteristic, he finds holes in the band which cannot be located with more conventional setups. Indeed, on many occasions, I have tuned in broadcast stations on adjacent 10-kc channels, each having a signal which rocks the boat, and then have returned to put the 3-kc passband exactly between them and watched the S-meter fall almost to zero. If the modulation of each station is voice, the receiver goes almost silent. For our purposes, such an opening on a ham band would be considered a clear channel.

If I wanted to listen to an AM station's upper sideband and get nearly infinite rejection of the lower sideband, the system to use would be simply the mechanical filter by itself as described above. A system of sum and difference heterodyning with separate oscillators would give sideband selection. But please don't stop reading yet; there's more to come. Passband tuning!

While the homebrew receiver I'm using this device on has many other features (product detection, hang avc, always-active S-meter, squelch, and a panoramic display in the works) the thing I'm talking about here is simply the mechanical filter circuitry.

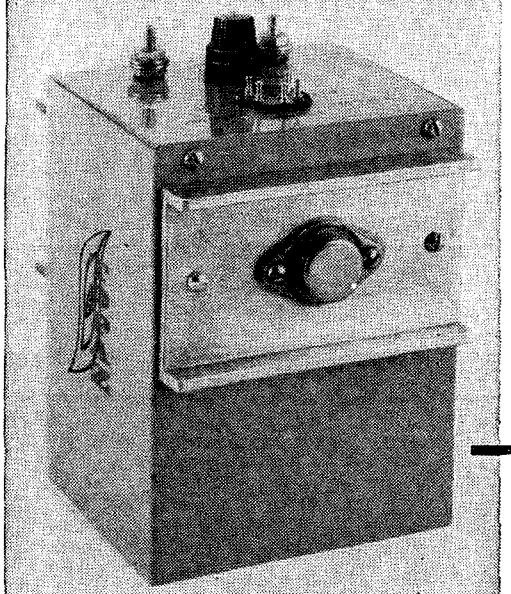
The device is basically a superhet circuit with a restricted tuning range (10 kc at the most) and an input frequency derived from the original receiver's intermediate frequency, which in my case is 915 kc. The block diagram identifies components.

Since the receiver *if* is 915 kc and the intermediate frequency of the device (which I'm going to call the slicer from here on in) is 250 kc, determined by the filter, obviously we must have a mixer somewhere.

This mixer is the first stage of the slicer. To develop the desired 250 kc output, we must feed it either 665 kc or 1165 kc in addition to the 915 kc input from the receiver.

As I said earlier, you could use separate

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oscillators to get these frequencies—but that approach gives you four separate oscillators (first L. O., two slicer oscillators, and the BFO) in the complete receiver. This approach does it with three.

To eliminate the extra oscillator, we build up a stable oscillator at the receiver *if* of 915 kc. The important thing in construction of this oscillator is to keep it reasonably isolated from everything but the circuit it feeds if you wish to have tweet-free tuning without the BFO on. Physical separation between this circuit and the *if* input, shielding of long leads, ceramic bypasses across the heater leads, and short component leads within the circuit accomplish this isolation.

The 915 kc signal produced by this oscillator is fed into a mixer circuit along with a signal from the 250 kc BFO. Everything about this mixer is standard, with one exception. In its output you have a choice of two bandpass filters, one tuned to 665 kc and the other to 1165 kc. They are selected by a tap switch, and the output of the selected filter is fed to the mixer which is the slicer's first stage.

The remainder of the slicer is conventional *if* and detector circuitry[2] which should give no trouble to a confirmed homebrew addict.

Bandpass tuning is achieved by bringing out what would normally be the BFO pitch control to the front panel. Now, when the BFO frequency is changed, let's see what happens. Assume you're listening to a station on 14.105 kc. The receiver is tuned so that his signal is at exactly 914 kc when it enters the slicer. With the BFO at 250 kc and the injection switch set to 1165 kc, his signal is transformed to 251 kc to go through the filter. In the detector, it beats with the 250 kc BFO signal to give you a 1000-cycle output. All is well.

Now, assume a kilowatt opens up on 14.107 kc. His signal comes to the slicer at 912 kc, is transformed to 253 kc, goes right through the filter along with the signal you want, and beats with the 250 kc BFO in the detector to give you a screaming 3 kc QRM signal. All is distinctly not well at this point.

However, you adjust the BFO "pitch" knob and change the BFO frequency to 252 kc. The injection frequency fed to the slicer's mixer is automatically changed to 1167 kc. This mixer transforms the incoming 914 kc signal (the one you want) to 253 kc which goes through the filter and beats with the 252 kc BFO to give you the same 1000-cycle output you had before. The interfering 912 kc signal becomes 255 kc after mixing with the 1167 kc injection of the slicer, and is rejected by the filter.

This electrical ganging of the BFO and the slicer mixer let you push interference over either side of the filter. It works equally well in either position of the sideband selector switch, but the 1165 kc injection position gives you a steeper cliff to push the QRM over.

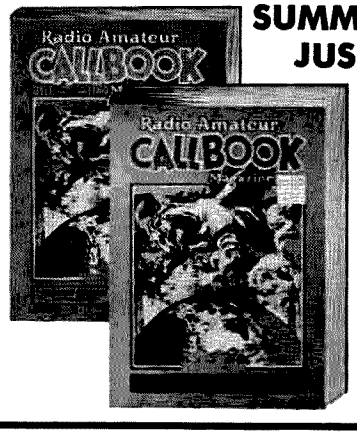
For the CW gang, about the only thing left to be said is that 300-cycle-wide mechanical filters are available now for as little as ten bucks.

Needless to say, the BFO pitch is attained by tuning the signal to the desired part of the passband with the main tuning controls. The BFO frequency controls only the position of the passband with relation to the receiver *if*. However, this is no drawback in operation. Once you tune the station to the pitch you want, you can sweep the passband back and forth around it and the pitch won't change by even a cycle.

A word about schematic diagrams. The receiver of which this system is a part was designed to fill my own special desires, and I'm sure that not one of you would want to duplicate it item by item. Every circuit in the system is standard and has been published elsewhere[3] only the way in which they're put together, as shown in the block diagram, is unusual. Therefore schematics have been omitted as unnecessary; use the idea with any pet circuit you have. ... W9OFD

[2]See the technical article "The Diligent Detector" in the January issue if you need AM detector ideas, or "Beat Generation" in the February issue for SSB and CW detector circuits—editor.

[3]For schematics of indivdual circuits which may be used, see our series of technical articles on receiver circuits in the November through July issues. Other circuits may be found in the Radio Amateur's Handbook or in the Radio Handbook (available from Radio Bookshop)—editor.



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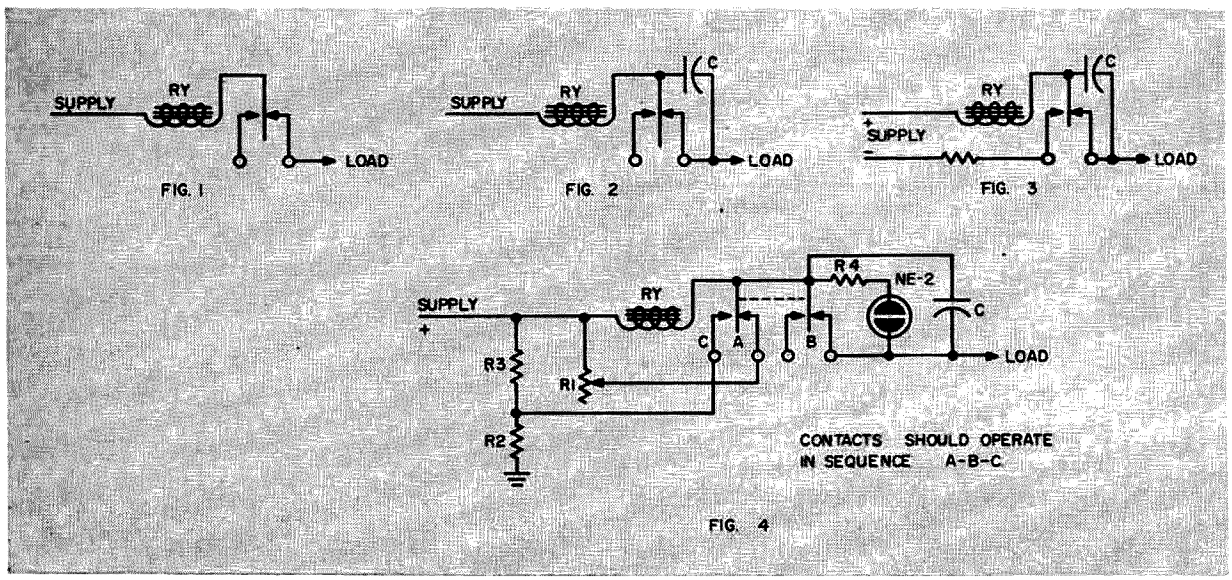
Observe Fig. 1. With a relay connected thus, it will just buzz when the current exceeds the pull-in value for the relay. An audible warning, but no protection. If we add a capacitor, the buzz slows to a rattle, as the contacts stay open while the capacitor charges (see Fig. 2). Still no protection. If we add a resistor, as in Fig. 3, the relay will pull in and disconnect the load and substitute the resistor. If the resistor has a low-enough value, the relay will remain in this position, the load disconnected, until the power supply itself is turned off, cutting the current and releasing the relay.

This is fine, except it doesn't protect the power supply too well, and the pull-in point depends entirely on the relay. So let's see Fig. 4. Here a variable shunt has been added to adjust the pull-in current. And a pair of contacts are used to disconnect the shunt so the holding current will be just that of the relay. The holding resistor now does double duty too, as part of the power supply bleeder. And a neon light indicator shows if the breaker is open and still connected to a load.

To add this gadget to a power supply, you must know ohm's law and have an ohmeter. Proceed as follows—First, find a 24 to 28 volt relay, DPDT. Measure its resistance in ohms, and determine from that the current it will draw at 24 volts. This will be somewhat greater than the pull-in current, of course, and about 50% greater than the hold-in current, but to be safe it's best to use this value in our calculations. The shunt resistor, R1, is so calculated that in parallel with the relay resistance, the voltage drop at the overload current is 24 volts. Use a wire wound variable, but be sure the wire will handle the current. The series resistor, R2 is calculated to pass the relay current at the power supply voltage. The bleeder resistor, R3, is calculated to pass 10 ma at the power supply voltage with R2 in series with it. The neon resistor, R4, is figured as 150 K ohms for every 100 volts of power supply.

Supposing we have a relay for 24 volts that measures 300 ohms. The normal current will be 24 ÷ 300 = .080, or 80 ma. We want to protect a 600 v power supply at 250 ma. 250 ma — 80 ma = 170 ma, the current thru R1. R1 then equals 24 ÷ .17, or 141 ohms. An adjustable resistor good for about 200 ma or more can be used. R2 will then equal 600 v divided by 80 ma, or 7500 ohms. Its wattage is 600 × .08 or 48 watts. R3 plus R2 equals 600 divided by .01, or 60,000 ohms, so R3 should be about 50 K ohms. R4 is 6 × 150 K, or 900 K ohms, so a 1 meg. resistor will be OK. Capacitor C is .5 at 600 v.

Should you wish to experiment, R2 can be a higher value, perhaps, as the holding current will be less than 80 ma. R1 could be determined precisely by placing a milliammeter in the circuit to measure the load and with the load set



at the desired value increasing R1 until the breaker trips. R1 can be an adjustable rheostat, and its pointer calibrated in ma.

While any relay of the DPDT variety will work, it is better to have one that requires moderately low current so that the size (wattage) of R2 will not be too large. Higher voltage relays entail higher voltage drops and more loss of power supply voltage. 24 vdc relays, so common and cheap, will seldom cause more than a 12 v drop in normal use. 12 v relays can also be used, but many of them take more current than you may want to protect against (250 ma is a common 12 v relay current.)

To re-set the breaker, just turn the voltage off. If the short or overload continues, the breaker will break again as soon as voltage is applied. It can be made adjustable from the panel if desired. About the only precaution to be taken in installing it is in insulating the relay from ground, as most 24 v relays were not insulated for high voltages (over 250 v). The capacitor C should be able to withstand the high voltage and should be of fairly high capacity, at least .5 mfd. If adjustments can be made to the relay, contacts "B" (load) should open after "A," and just before "C" closes. It is sometimes possible to reduce the current requirements of the relay by reducing the spring tension a bit. These last suggestions are for the experimenters.

Put one of these things in your rig. It may save its cost or more in rectifiers the first time it works! ...WϕOPA

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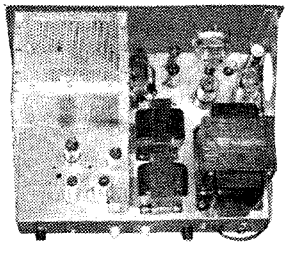
Gain Figures, Radiation Patterns and Catalogs Listing All Models are Available



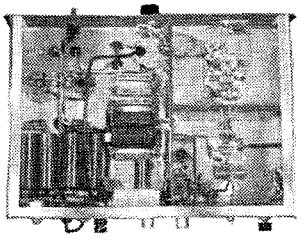
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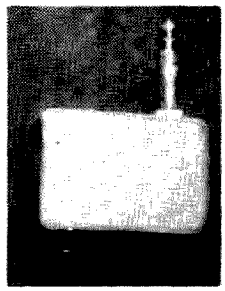
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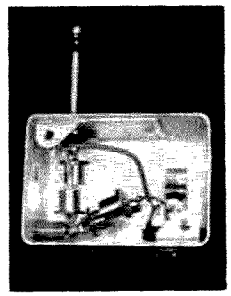
* Slightly higher west of Rockies

P&H ELECTRONICS INC.
424 Columbia , Lafayette, Ind.

A 73¢ Noise Clipper

James F. Garrity KφWML
1228 Ashland Avenue
St. Paul 4, Minnesota





Photography by Bob Jacobs.

ONE of the handier accessories in the shack is the noise clipper. Connected between the audio source and the headphones, it will chop off noise peaks and prevent excessively loud signals from getting through to your ears. In most cases it can be used without modification to the receiver, which should appeal to the owners of commercial gear. Best of all, it costs only 73¢ (or rather, it cost me 73¢; it will cost you somewhere in the neighborhood of 57¢).

The circuit is shown in Fig. 1. The clipping action relies on the forward conduction curve of silicon diodes, shown in Fig. 2. So long as the signal peaks stay below the knee of the curve, the clipping is insignificant. However, if a noise peak goes over the knee, the diodes will conduct heavily and, combined with the internal resistance of the source, limit the peak to one or two volts. Another way of looking at the clipping action is to picture a five ohm resistor which is shunted across the headphones during noise peaks. The resistor bypasses most of the noise. Incidentally, this also explains why the clipper will not work effectively with a speaker. Five ohms shunted across a four ohm speaker won't reduce the volume appreciably.

Although any of the common silicon power rectifiers will work in this circuit, the TAB diodes were specified from an economy standpoint. Similarly, the MC-385 provides the chassis, plug and jack at minimum expense. Originally, it was used to transform low impedance headphones for use in high impedance circuits, and the miniature autotransformer it contains should have some possibilities in transistor work.

Construction takes about thirty minutes. First, remove the cover to the MC-385 and remove the transformer. Next, connect the diodes in pairs, as in Fig. 3. Don't allow the diode cases to touch. Solder one end of the first pair to the plug connection. Use short leads or the diodes won't fit in the case. Connect one lead of the second pair to the ground lug on the jack, again with short leads. Connect the remaining leads of each pair together in midair or to a solder terminal. Finally, connect a wire from the plug to the remaining lug on the jack.

To use the clipper, connect it between the audio output and the headphones. The clipper will work in any of the common output circuits, except the ones shown in Fig. 4. In that case, the dc voltage drop across the phones will bias one set of diodes into conduction, effectively rectifying any signal (new detector, maybe?). A word of warning: if you have a high-powered audio system (like push-pull 6L6's) it is possible to exceed the dissipation ratings of the diodes on high volume levels. At one watt each, the limit for the clipper is four watts. . . . KφWML

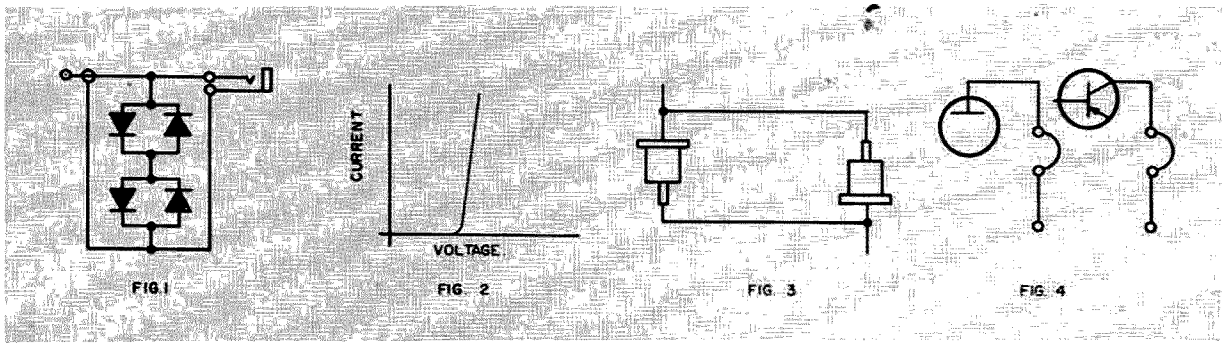


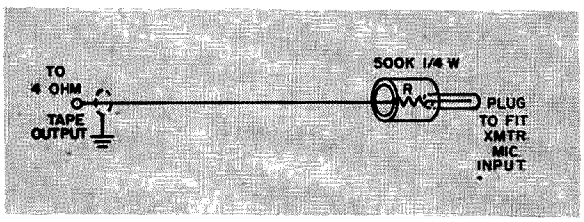
Fig. 1 4 diodes 25 piv 750 ma @ 9c each from TAB, 111 Liberty Street, New York 6, N. Y. One MC-385 @ 6 for $1.00 from Selectronics, 1206 S. Napa Street, Phila., Pa.

Fig. 2 Forward conduction curve of silicon diodes.
Fig. 3 Arrangement of diode pairs.
Fig. 4 Clipper won't work in these circuits.

"T.R." on SSB

Ted Wilds KZ5SW
Box 2519, Balboa,
Canal Zone

A FEW years ago with the advent of the low-cost tape recorder many of us obtained one for family use. After the "new" had worn off recording the children, party tapes, and not-so-hi-fi dubbings of the top ten tunes of the day, many of these units were either relegated to the storage closet or saw temporary service in the ham shack. It usually did not stay in the shack too long because of the tedious procedure used on AM. It necessitated recording a CQ or directional call, rewinding the tape, playing it back on the air, and if no results were obtained, rewinding, rethreading, usually, and going thru the process

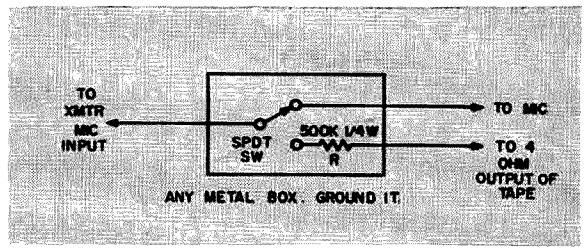


Tape output may be up to 16 ohms Z. If 500 raise value of R to prevent input stage overload. Try 3 megohms to start, and adjust as required.

over again. It wasn't worth the effort. With sideband, or other VOX operation, the tape recorder can be a real convenience. It is possible to use a tape deck to advantage with practically no effort. The secret of this new convenience is the "closed loop" of tape. With it you can make a 15 or 20 second call followed by a period of listening, then the whole deal repeats itself all automatically. I find it particularly useful for calling schedules, directional CQs, and for opening up a band that sounds dead from lack of activity.

Basically, this is how it works. You cut an 8 to 10 foot length of heavy duty (MYLAR preferred) recording tape and splice the ends together forming a loop of tape. This you put on your recorder, with the excess hanging over the back of the table or desk. A small weight in the form of loop solder is hung on the dangling bottom of the loop. This pulls the tape so it won't foul up in the capstan. When you make the splice in the tape, use a colored cellophane tape or the regular white splicing tape. The reason for this is to have a visible "beginning" and "ending" spot. Set your recorder on the slowest speed usually 3⅓ i.p.s. and time the interval that it takes the colored splice to make one trip thru the machine. This should be from 25 to 40 seconds. If it is less than 25 seconds make a new and longer loop. Now, using the microphone that comes with the recorder (for simplicity) make a 15 second "TESTING" transmission and sign your call. This will leave about ten seconds of dead air on the tape. Play it back and listen for two possible defects. One is noise on the tape during the dead air period. If any shows up, let the tape run thru the machine on "record" with the volume down to clean off any previous recording, so that the noise won't trip the VOX in the "listen" period. Re-record your brief test transmission. Secondly listen to yourself for undue pauses between words that will allow the VOX to drop out unnecessarily during the transmitting period of the cycle. The object is to make a smooth transmission followed by a dead air period when the VOX will drop out and turn the receiver on.

Now let's consider the use of the tape machine with the rig. The simplest way is to put the station mike in front of the recorder speaker and let it run. Adjust the volume of the recorder so that it trips the VOX smoothly. At the end of your test transmission, the dead air period will let the VOX drop out and the receiver operate. This will repeat itself over and over again until you shut the darn thing off. Unless you have an unusual fondness for



the sound of your own voice, you will want a silent means of doing this, particularly if your scheduled station is a few minutes late!

Most home type tape machines have a 4 ohm external or auxiliary speaker output jack. Make up a connecting cable with a plug on one end that will fit the microphone input jack on your transmitter. On the other end put a plug that fits the 4 ohm output jack on the tape recorder. In series with the *hot* lead in one of these plugs put a half megohm ¼ watt resistor. If you want to get real fancy, make up a small switching box as shown in the diagram.

The on-the-air procedure is to make a recording calling your scheduled station using his call about three times followed by your call once, with the rest of the loop blank. Turn on the tape in the playback position and sit back and relax. All you will hear will be the receiver noise during the "listen" portion of the tape until your station comes back to you. When he does, turn off the tape, plug in your

(Turn to bottom of page 40)

Phase Inversion

Dean Cupp W4JKL
Route #4
Morristown, Tennessee

Since the advent of phone transmission, hams (engineers too) have been striving to increase the effectiveness of the modulator be it AM, SSB, or FM while keeping the size, cost, weight, and complexity of the circuits to a minimum.

Although the circuit shown here may not increase the effectiveness of a rig to kilowatt proportions, I feel it will help with all the other qualities mentioned. Now, before someone dies of curiosity, Fig. 1 is a unique circuit

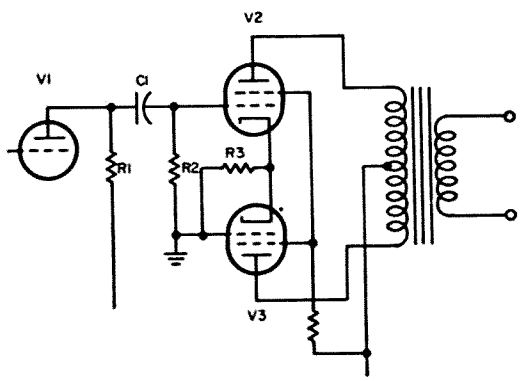


FIG. 1

that provides phase inversion right in the push-pull output stage of a driver, modulator, or audio amplifier. This eliminates the need for a phase inversion stage (complex) or interstage transformer (heavy, large, and expensive). At this time all CW men should QSY to the page labeled de W2NSD, unless they care for hi-fi or some such.

V1 is an ordinary speech amplifier stage, V2&3 is the yank-shove output stage. Assume the signal across R2 goes positive (less negative) causing larger plate current to flow in V2, which causes more voltage drop across the cathode resistor R3 (cathode more positive to ground). The grid of V3 is grounded and the increasing bias reduces the current through V3. When the grid of V2 goes more negative the opposite happens: less current flowing through V2 causes less drop across the cathode resistor, and more current in V3. Presto: phase inversion, exactly 180 degrees with no worries about matching resistor and capacitor values or paying for a transformer. R3 is the normal cathode resistor for class A or AB1 operation.

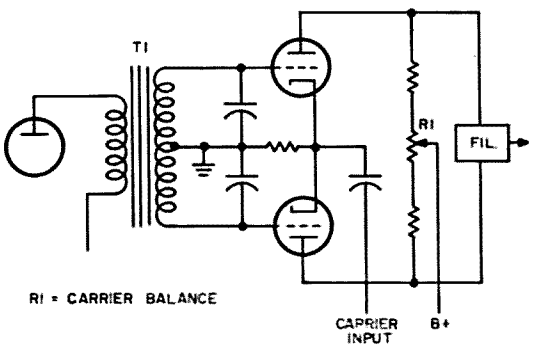


FIG. 2

Other classes of operation should not be attempted since they require power that a voltage amplifier can't deliver. There's little choice but to use a transformer when using AB2 or B, since a phase inverter can't supply the power either. R1, R2, and C1 are the values

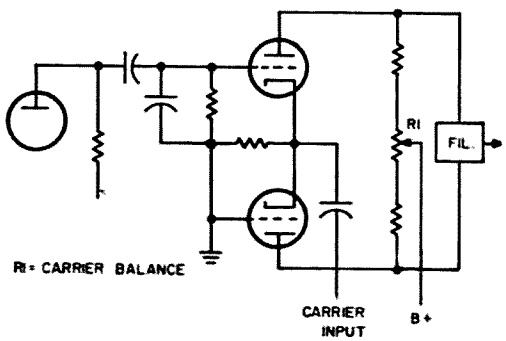


FIG. 3

normally used with V1. *Do not* by-pass the cathodes of V2&3, this would make V3 inoperative. (Note: this circuit also saves the cost of the by-pass.) AM fellows may stop here and let the SSB fans read on.

The following is not solder-no solder directions, but food for thought. Fig. 2 is a common balanced modulator. Fig. 3 is a modified version using the circuit of Fig. 1 to achieve phase inversion. The audio is fed to the grid, rf to the cathodes. This might be tried with different types of balanced modulators. Although I have not tried the SSB version everything indicates it would work and I am quite interested to hear from anyone who tries it. How brave are you? ... W4JKL

(Continued from page 38)

station mike instead of the recorder cable and proceed normally.

This gadget is particularly useful for contest operation, where you make the same CQ Contest call many many times during a weekend. The MYLAR tape was suggested earlier because I find that acetate tape will wear out in a relatively short time. A MYLAR loop lasts me about three months of daily use. (For the uninitiated: you *must* have VOX operation for the system to work!!!). If you want to have some fun, tape-call your local buddy on the air and call him on the landline at the same time. He do get confused!

... KZ5SW

an Electronic Keyer

Al Brogdon, W4UWA/K3KMO
316 West Fairmount Avenue
State College, Pennsylvania

for lazy, stingy perfectionists

IF you are by nature a lazy person, who likes to be able to send CW without having to poke out each character—and stingy, so you want an electronic keyer for under $20—and a perfectionist, so you want nice self-completing characters—read on.

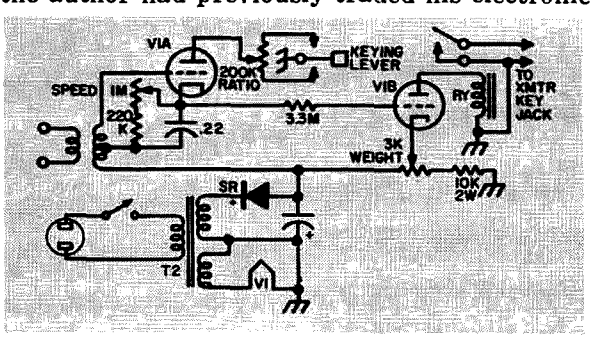
The original circuit from which this keyer evolved was developed by G. Franklin Montgomery, W3FQB, and was published in the March, 1952, issue of CQ magazine. As an indication of its quality, the basic circuit has been outright copied or slightly modified for use in composite circuits over a half dozen times in later issues of CQ and QST. This is the same circuit as the one in the 1960 ARRL Handbook, which was the first electronic keyer circuit ever to appear in the Handbook.

Correspondence with Jack Gallagher, W5-HZB—another electronic keyer designer of wide-spread fame—brought to the attention of the author (me, in other words) the W5HZB simplification of the W3FQB circuit. This modification produced equal quality CW with one less triode section than the original circuit. After a few more simplifications by the author, the circuit as shown in Fig. 1 was found to be the simplest possible circuit that would produce good, reliable CW.

The Field Day Special

The local Nittany Amateur Radio Club was making plans for Field Day 1960 and was desperate for CW operators. As a last resort, they invited the author, who holds the Amateur Extra First Class Lid License, to participate on the 420 mc CW position. Since the author had previously traded his electronic keyer in a horse-trade, it was obvious that another keyer must be built in short order. The keyer as shown in Fig. 2 was built in a great hurry. This model was built on a used chassis, utilizing existing holes, and was rewired several times in the process of getting the best performance. This resulted in the rat's nest of wiring as shown in Fig. 3. Allow me to digress. Most amateur radio magazines show pictures of the undersides of electronics equipment with nice, neat work, wiring harnesses and the works. The author is sure that the readers of 73 will enjoy, for a change, seeing a piece of equipment that looks as bad as anything they ever built.

The Stikky Peanut Butter jar is actually the plate-sensitive relay. The jar was part of the relay, serving as a dust cover. The label was added as a touch of color, and came from Mad magazine. The switch hanging by one hand from the left side of the chassis is a SPDT spring-return switch which is used to close the key in one position, for tuning purposes, and to turn the VFO on in the other position, for frequency spotting. It is not shown in the keyer schematic, but may be added as desired.



Parts List

V1—Dual triode: 6SN7, 12AT7, 12AU7, 6CG7 are OK.
T1—AF Transformer with push-pull winding. Secondary not used.
T2—120v @ 20 ma, 6.3v @ 300 ma, minimum.
SR—Selenium or silicon rectifier, 50 ma minimum.
C1—30mfd is good, more is better. 150vdc.
RY—See text.



Fig. 2

For a discussion of the theory of operation of this keyer, refer to either the 1960 ARRL Handbook, or the original article in March, 1952, CQ. Basically, V_{1a} is a saw-tooth oscillator, and V_{1b} is a limiter, so that the output is approximately a square wave.

The relay used for this circuit should be a plate-sensitive relay that pulls in at 3 ma or less. The Sigma 41F-5000S-SIL or equivalent (5000 ohm coil) would be a good relay for this keyer. However, a good buy in a relay may be found in the current Burstein-Applebee general catalog (bargain section, where else?). The catalog number for this relay is

18B156, and the cost is $3.95. This is a Sigma relay (Sigma number unknown) with a 16000 ohm coil, and fully adjustable contacts, which is a necessity for the best adjustment and, consequently, the best operation. This relay is shown on W3SMV's keyer in Fig. 4. W3SMV's circuit is the same as Fig. 1, using a 12AT7. From his observations, the 12AT7 is the best miniature tube for this circuit, with either a 12AU7 or 6CG7 being perfectly acceptable substitutes.

Incidentally, while you have the B-A catalog open to the bargain section, check for a small power transformer and an audio transformer with a push-pull winding. You will find they also have good prices on these items.

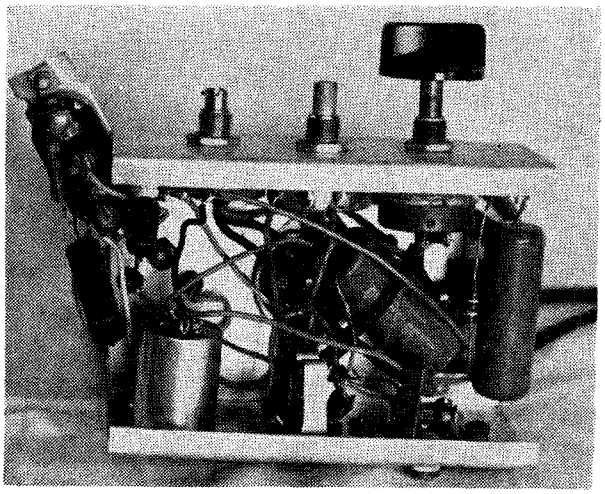


Fig. 4

Keyer Adjustment

The relay should be carefully adjusted for best operation with this circuit, or any electronic keyer circuit. First, push the relay closed by hand and adjust the closed contacts so that good, solid contact is made. Then, with the relay in the relaxed position, adjust the relaxed contact so that there is 1/32 inch or less spacing between the keying contacts.

Now set the weight control at minimum, and the other two controls (speed and ratio) near mid-range. Advance the weight control until closing one side of the key produces characters of some sort. Now adjust the ratio control for a dot:dash ratio of 1:3. One of the easiest ways to adjust this ratio is to send "dididididahdahdididididahdah," etc., adjusting the ratio so that the dit strings take exactly the same amount of time to send as the dah strings (four dots and the enclosed three spaces is equal to two dashes and the enclosed one space). After this ratio is adjusted, adjust the weight again so that the space between dots or dashes is equal to the length of the dots. Once these two adjustments are made (ratio and weight) they will not have to be touched again, so the controls may be

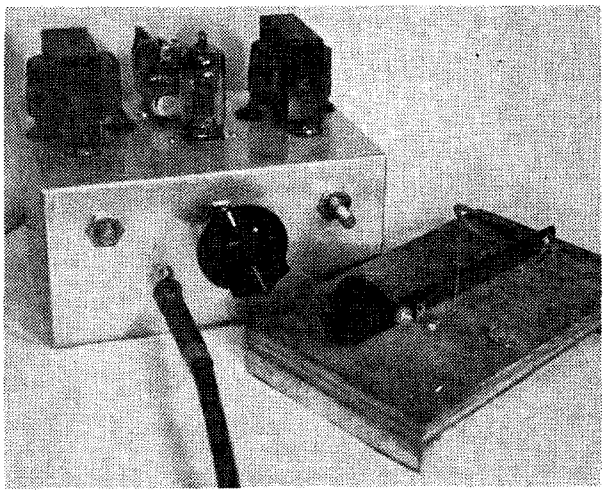


Fig. 3

put on the back panel or some other out-of-the-way place. The speed control may be varied throughout its entire range without upsetting these adjustments.

It should be noted that a good relay with soft silver contacts should not be used to key high currents, as in a transmitter where all stages are simultaneously cathode-keyed. Such use will cause the relay contacts to become dirty, eventually pitted, and will likely cause them to weld themselves together just as you snag some rare DX (Murphy's Law). The author's keyer is used to key a grid-block time-sequence system, where little current flows through the relay contacts. W3SMV uses his to key a Vackar VFO circuit, with all buffers and the final operated either with fixed bias or cathode bias.

If the speed range provided by this keyer is not what you want, changing the value of the speed control and the fixed resistor in series with it will change both the range of variation, and the highest (or lowest) speed available. Adding resistance causes the keyer to operate at a slower speed.

After you have built this circuit, and have the keyer operating properly, practice with it until you can send decent CW before putting it on the air. Nothing sounds so downright embarrassing as a ham learning to use an electronic keyer by getting on the air with it. Don't be like the fellow on 40 CW with a new Whaleyscrathers Straddyvarious keyer who said, "MHE KIYEL HR IH W J9TO MODEAS, 50W DOIS IT HOUNB?" The FCC, unfortunately, does not permit our telling him how it sounds.

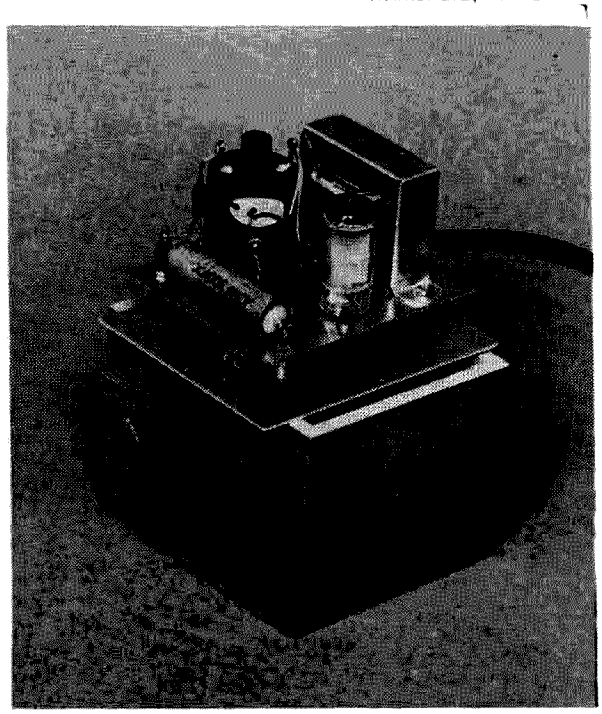
If you would like to hear the "Field Day Special" in operation, look for K3KMO either on the WPA traffic net or on the low end of 80 meter CW chasing DX.

Photo credit goes to Carl Volz, Jr., W3SMV. For the benefit of the photo bugs in the reading audience, Carl made the pictures indoors with available light through a single window, using wet plates. . . . K3KMO

This gadget saves gas and patience if you are building a noise limiter.

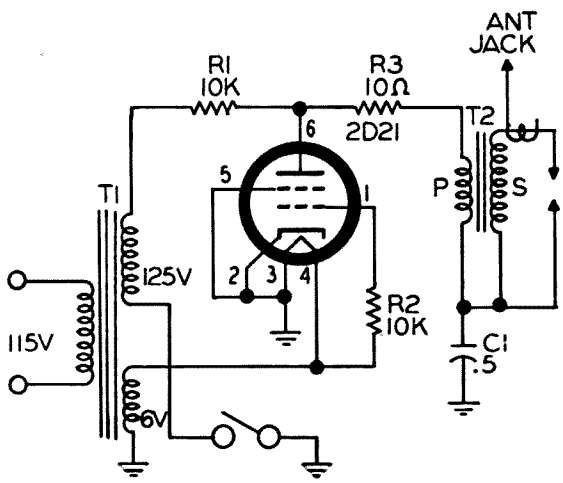
Tom Lamb K8ERV
1066 Larchwood Rd.
Mansfield, Ohio

the "Pop" Box



Now why would anyone want to generate ignition noise when 199,999 hams are trying to get rid of it? I'm not really sure, but don't tell Wayne or he may not print this. One possible reason would be to save gasoline. You did run the buggy to check that last noise limiter circuit, didn't you?

Actually, it is quite fashionable to fight noise with noise. Just as wide band noise generators are used to measure converter performance, so the Pop Box generates a stable ignition type of noise useful in testing the effectiveness of a limiter.



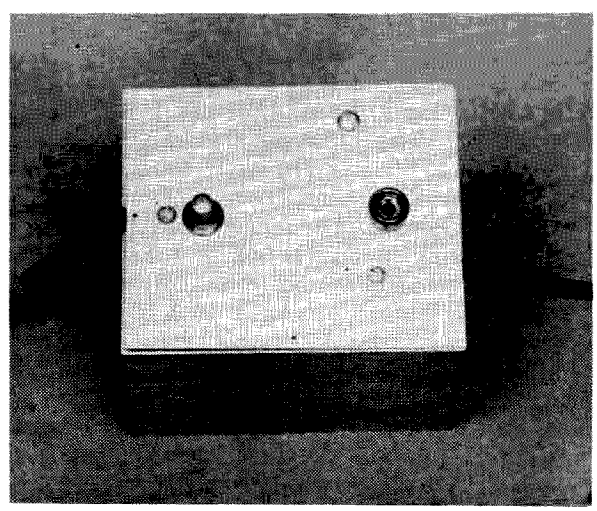
The schematic shows the Pop Box to be a miniature ignition circuit, with a thyratron for the points and a model coil for the spark. The thyratron grid is fed out of phase with the plate to prevent too early firing. Should the circuit not operate, reverse the 6v *or* the HV leads.

Construction

While I used a wood box, it would be better to use a shielded enclosure, such as a Minibox. The parts placement is not important. A piece of insulated wire wrapped around the HV terminal on the coil couples the spark pulse to the antenna jack. The spark gap is not critical so long as a stable spark is obtained. My gap was about ⅛".

Use

To use the Pop Box, just set it near your receiver and turn it on. If necessary, plug a short whip or piece of wire into the antenna jack to obtain the desired pulse strength. Now turn on the noise limiter and note the noise reduction. The main idea is that with a scope to show just what is happening, and the Pop Box to cause it to happen, a noise limiter circuit can be adjusted for best performance in your receiver. . . . K8ERV



Selected Circuits

Roy Pafenberg W4WKM

MUCH communications equipment, designed for other than the amateur market, contains circuit features worthy of incorporation in amateur constructed gear. One such equipment is the Model SB-6F single sideband transceiver manufactured by RF Communications Associates of Rochester, New York. This transceiver is rated at 125 watts PEP and is provided with 6 fixed tuned channels in the range of 1.6 to 16 mc.

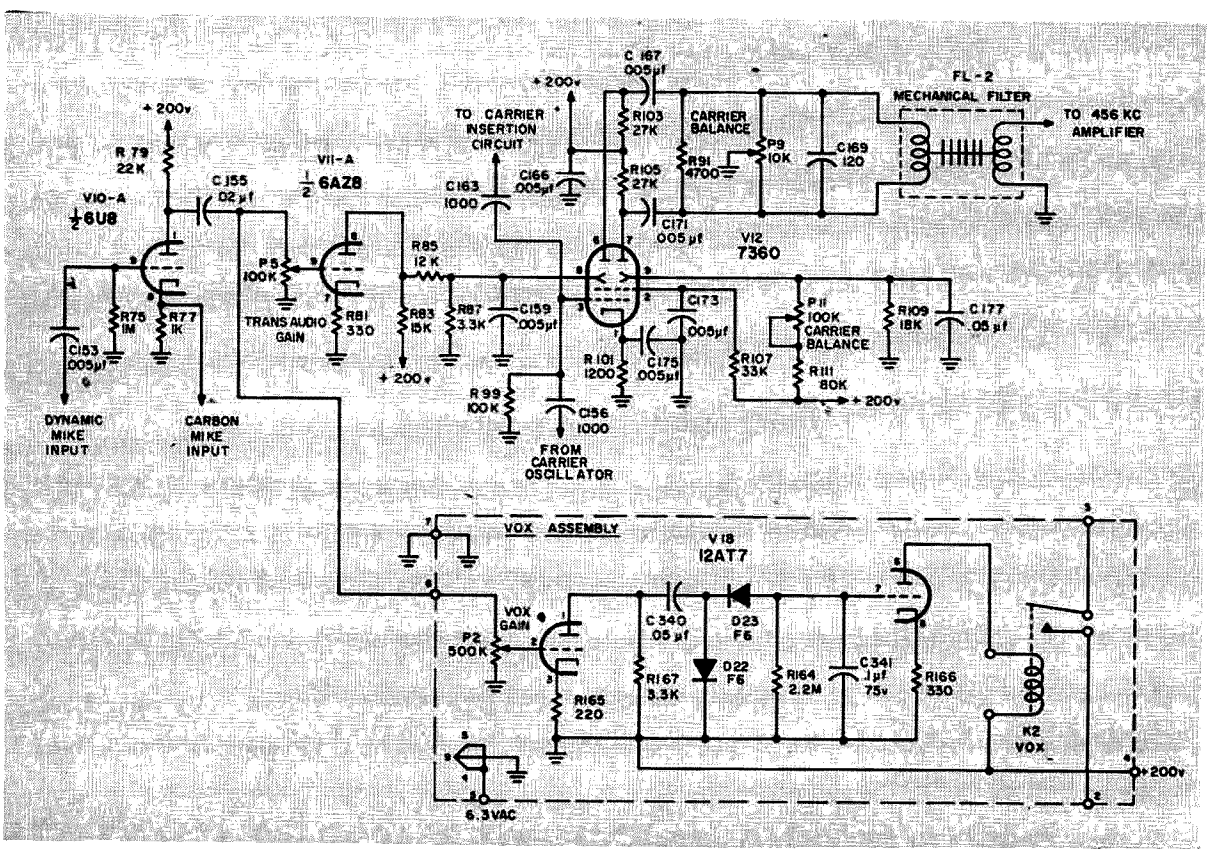
The equipment is aimed at the commercial communications market and is designed to be operated by non-technical personnel. Built to commercial standards, it provides top performance and, for such equipment, is nominally priced at around $1,300. While few amateurs would be interested in the transceiver for use in the ham bands, certain circuit details are worth considering for your next SSB rig.

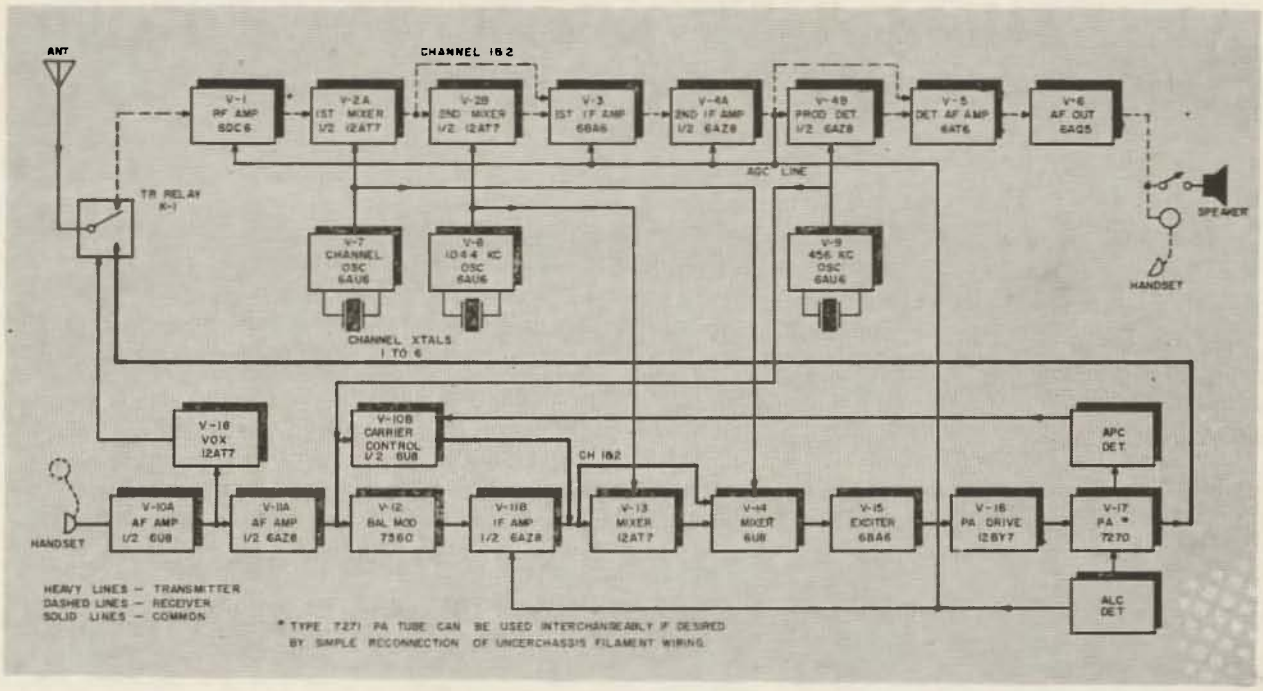
The schematic diagram shows the sideband generating portion of the SB-6F, along with the audio and VOX circuitry. The block diagram shows how it fits into the system. The schematic has been simplified by removing some of the Transmit-Receive switching circuitry and showing the circuit in the transmit SSB condition.

Although the speech amplifier uses the conventional dual-triode circuit, two inputs are provided. A high impedance dynamic microphone may be connected to the 6U8 grid circuit or a carbon microphone connected between the 6U8 cathode and ground. The unused input should be grounded in either case

The VOX assembly, available as an accessory to the SB-6F, is about as simple as such a device can be. The voltage doubler audio detector uses a pair of 1N2484 silicon diodes and insures adequate control voltage for reliable operation. This voltage doubler technique is a good one to remember since it can often save a stage of amplification. The relay, K2, is a 10,000 ohm, 2.5 ma unit.

The heart of any sideband exciter is the sideband generator proper. In this transceiver, an RCA 7360 beam-deflection balanced modulator feeds a 2.1 kc Collins mechanical filter. This happy marriage results in a *maintainable* 50 db suppression of carrier and undesired sideband. Those who have fought the battle of maintaining transmission standards in SSB communications systems will appreciate the importance of this claim. The 7360 circuit is less complex than some that have been published, however it is capable of providing good balance and excellent carrier suppression. Both carrier (P11) and quadrature (P9) balance controls are provided. Carrier is injected to the control grid of the 7360 through C156





which is connected to the untuned plate circuit of a 6AU6 Pierce oscillator. C163, which is also connected to the 7360 control grid, couples a portion of the carrier signal to an AM carrier insertion circuit which is not shown.

The information presented here has been made available by RF Communications Associates, Inc., with the understanding that its publication does not constitute a license for commercial use of the proprietary portions. However, if some of the circuit features discussed turn up in amateur constructed equipment, then this article will have served its purpose.

. . . W4WKM

Review of the

Cornell-Dubilier AR-22 Rotor

The CDE Model AR-22 Rotor was my choice to rotate an 8-element 2-Meter beam because I was mounting a ground-plane above the beam and needed a rotor rugged enough to withstand the combined weights of the two antennas. In addition, I planned to eventually mount a stacked 8-over-8 on this rotor, and one of the offset rotors probably wouldn't stand the strain for very long. The in-line design of the AR-22 makes it the only TV-type rotor that would be dependable enough for the job and still provide the convenience of automatic positioning.

Because of the automatic positioning feature, I am able to log the dial readings for the directions of those stations with whom I hold repeated QSO's and thus be able to put the beam on them with a flick of the control knob. The pointer of the control knob is set at the given direction, and the rotor then turns until it reaches that direction, where it automatically stops. The accuracy with which the antenna finds the chosen direction makes it possible to spot weak stations that I must find for nets, skeds, etc.

The AR-22 is very easy to install. It uses inexpensive, readily available 4-wire control cable. Although there are detailed instructions for synchronizing the rotor with the control box (an easy procedure), I found that mine was already perfectly synchronized when I first tried it.

A transformer in the control box changes the 110 volts A-C to 24 volts for the control cable and rotor unit, in accordance with electrical codes. (Many hams are illegally and hazardously using rotors that have 110 volts on the control cable and rotor unit.)

I can give one word of caution to anyone installing any rotor: Be sure to leave a large enough loop in the antenna transmission line where it passes around the rotor. I learned this the hard way, because I didn't leave enough on my ground-plane lead. The first time I rotated the antennas, the AR-22 showed off its mighty power by snapping my coaxial cable in two!

My installation has been up for about nine months, and neither blizzard nor extreme cold has affected its operation. There has been no sign of drift, even in the extreme winds that whipped across my hill-top location last winter.

The AR-22, together with plenty of control cable, cost less than $35. Since this is only about $10 more than the cheapest TV rotors, it is certainly a bargain in extra performance features.

. . . Lloyd N. Gardiner K2PSW

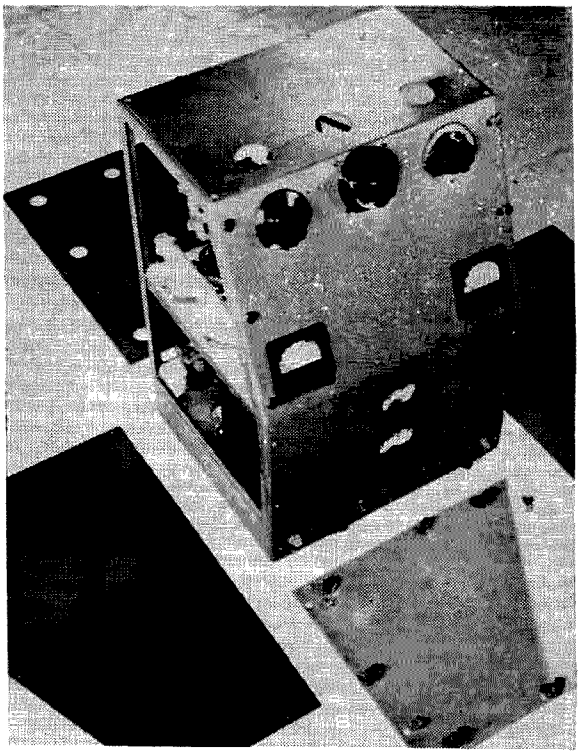
tame one of these medica monstrosities and you've got a real bargain-type KW!

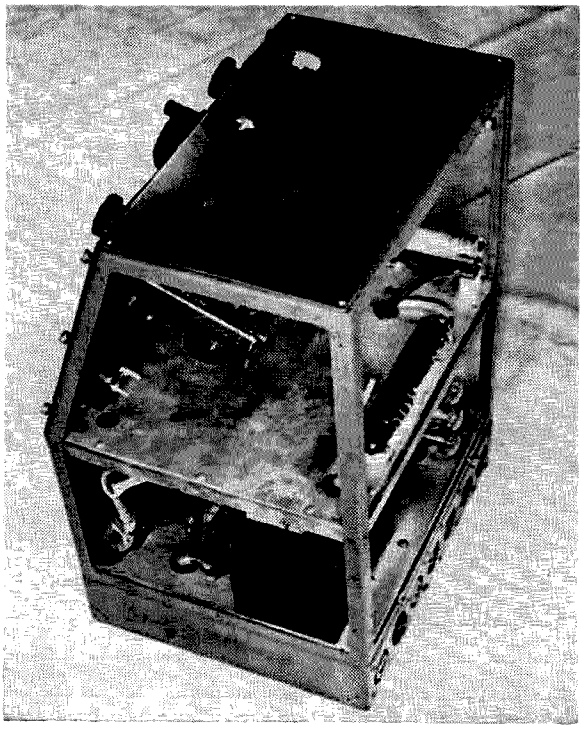
Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Ionospheric Heaters

MANY newcomers to amateur radio may not be familiar with the wandering, raw ac signals that once rendered large segments of the high frequency untenable. Medical treatment diathermy equipment manufactured in the late thirties and early forties consisted of a high power oscillator fed from a raw ac or, at best, a rectified and unfiltered dc plate supply. No means of frequency stabilization was employed and adherence to allocated frequencies was a hit or miss proposition. The powers used and the application of this equipment are such that complete and effective shielding of the equipment and the treatment room would be required to reduce interference to a tolerable level.

With these devices becoming more popular, showing up in doctor's offices and clinics all over the country, something had to be done and was. The FCC outlawed the use of the older equipment and set up strict standards governing the design and use of radio frequency heating equipment. Older equipment was made obsolete by these regulations and, having little if any resale value, rapidly became a drug on the market. Much of this gear was given away or junked. However, even at this late date, there is a substantial quantity gathering dust in doctor's basements and clinic storage areas.





The amateur who will search out this equipment can acquire a good selection of heavy duty power supply components at little or no cost. Also, the configuration of many diathermy "machines" is ideally suited to amateur construction. The schematic diagram of a Burdick Corporation device, a fairly typical unit, is shown in Figure 1. Plug-in assemblies are used to provide output on 3.75, 12 and 50 megacycles to meet various treatment and surgical requirements. The rf components used in most equipments will have little attraction for the amateur; primary interest lies in the power supply and possibly the enclosure.

Power supply components in this equipment were heavy duty and designed for continuous service. Control systems in some models were

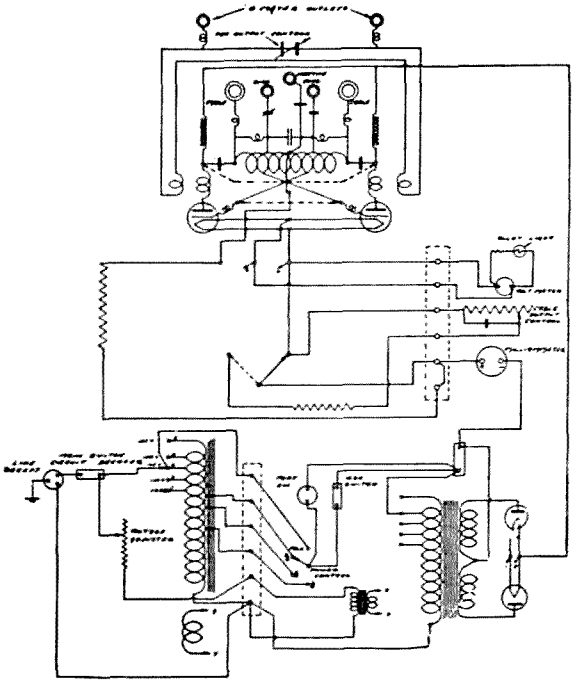


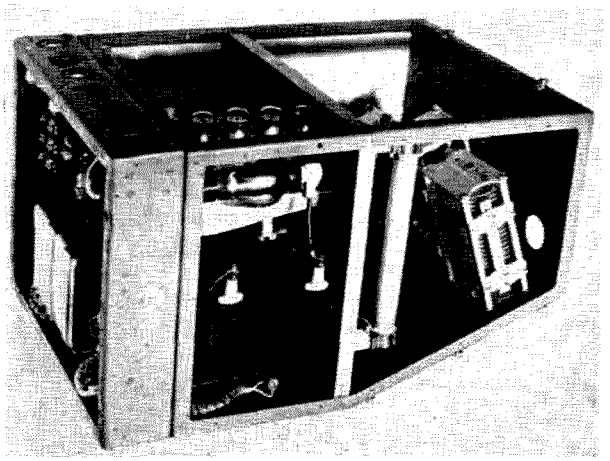
Fig. 1: Schematic diagram of a typical diathermy unit. This equipment was manufactured by Burdick Corporation and provided output on 3.75, 13 and 50 MC.

quite elaborate and easily adapted to amateur equipment requirements. Tapped power transformers with selector switches or Variacs were almost always used to compensate for a wide range of primary voltage and to permit adjustment of output power.

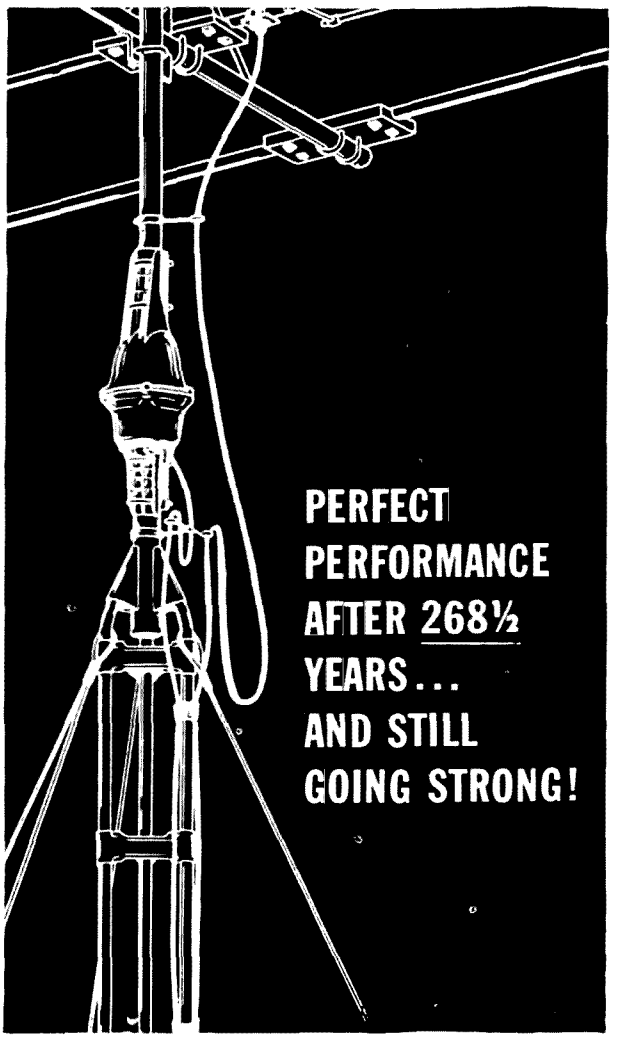
Inspection of Figure 1 will disclose that the addition of a filter choke and capacitor would result in an excellent high power plate supply. The photographs show a diathermy unit of unknown make and model adapted to amateur use. The power supply components of this particular unit are good for 2,500 volts at 500 ma which is a full kilowatt in anyone's book.

The captions tell the story and it is convincing. So get on your horse and start looking before it is too late. One word of warning: Wear old clothes and take help with you. Basements are dusty and these beasts are heavy!

. . . W4WKM



Photographic Credit: Morgan S. Gassman, Jr.



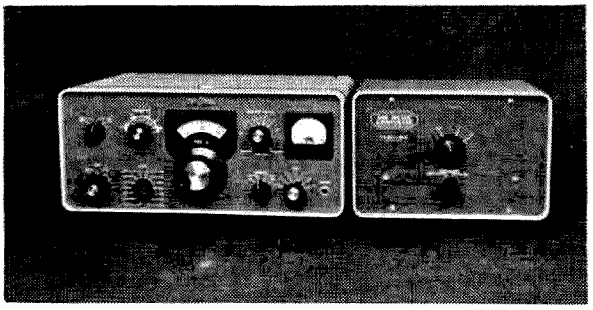
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That's the equivalent service, per rotor, of over 268½ years. Now that's dependability, the kind of dependability you have the right to expect from Cornell-Dubilier! What's more, the HAM-M is backed by the famous CDE lifetime factory service warranty.

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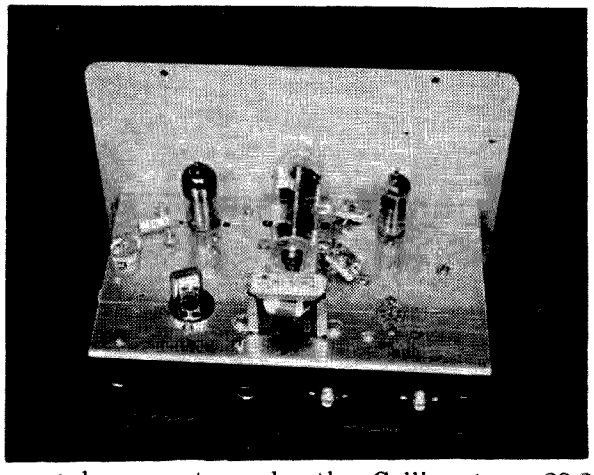
160 M Converter

Henry Cross W1OOP
111 Birds Hill Avenue
Needham 92, Mass.

LAST year the 75-meter DX was pretty good, so Dana W1HKK figured that this winter he should give 160 a whirl. He had a brand new 75S3 and wanted to be able to use it without messing up its other functions and features, so we made him a converter.

Before starting projects that look like work (for me) I like to get advice (free). W1BB said that coverage from 1750 to 2015 might be desirable for working foreign stations. W1FZJ said put in a good preselector Four guys on six said they used to like 160. Somebody on 220 said I was nuts. W1QXQ said there was no accounting for tastes, but he painted the panel.

After a month of discussion, I was nudged into doing something by Dana, who bought crystals, dug up a cabinet, and drilled some holes in the chassis (this explains the spare tube socket—I hadn't really made up my mind, but he was in a hole-punching mood.) The



crystals were to make the Collins tune 28.2 and so on to 28.8. Thus a 26.5 converter rock made the two US bands come out 100-125 on "28A" and 75-100 on "28B." It turns out the PRESELECTOR knob on the 75S3 need not be touched, but the rf knob on the converter wants repeaking about every 5 kc.

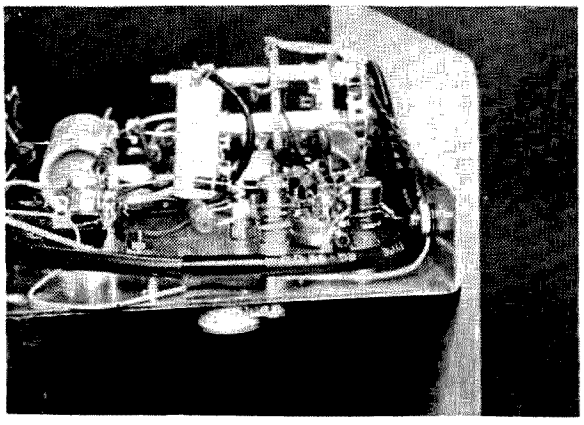
The photos and schematic show the final product. The converter could have been made smaller, but we can't imagine how it could work better. Power is stolen from the line cord (11-pin) socket of the Collins; only unfiltered 150 volts is available, so a choke and electrolytic are included. The filament drain (600 ma) seems small, and the main power transformer still runs cool. The receiver has no regulators, so we didn't bother either. The rf stage was set up for a gain control pot in the cathode, and this was installed recently. The schematic shows how to put one in. (More turns in L3 will give you some gain to turn down.)

The mixer stage is pretty ordinary, except that converters going UP usually have trouble with the LO being near the output frequency. An oscillator-frequency trap usually fixes this, so the 6U8 plate has one. To get injection a two turn coil in the cathode of the mixer is wound over the oscillator plate tank turns; the reactance is not enough to bother at two mc.

High Q in the rf coils is important; luckily the National "Blue Chip" series of chokes was built for use by filter-makers and the ferrite coils are excellent at 2 mc. I found that by removing 48 turns from no. B17331 220 microhenry coil I got the right inductance (tunes 2.1 mc with about 100 mmf) and a Q of 190. I tried Ferri-Loopsticks and other commercially available coils, nothing better than 130. The photos show a toroid input coil: it's better (I hand-wound it with 20/44 litz on carbonyl iron), the Q (unloaded) is 250, but how to get another? Incidentally, the National coils are wound with self-stripping litz, just push the celanese back and solder to the enameled strands. Be sure to get equal inductance in the two coils.

The crystal, and the circuit, are from International Crystal Mfg. Co. Ours hit within fifty cycles of 26.500.

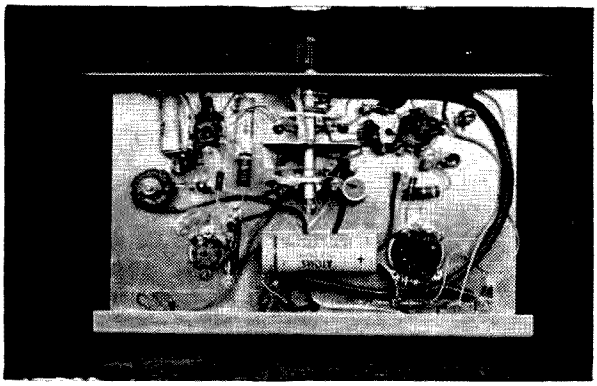
The "normal-through" switching (familiar to Gonset converter users) demands a two-section switch with a shield. A sheet of 1/32



inch brass did this; the switch was stretched, for convenience, by putting it on a separate index assembly (PA-302). The other shielding problem was that I forgot to ground the metal plate between the stators of the tuning condenser. The 6BJ6 oscillated until I remembered.

Tune-up

The B plus should be off the crystal oscillator. With a BC348, or a Sky Buddy, or something tuned to 1.9 mc plugged in the output (that 28 mc coil passes a *little* at 160) put a 1.9 mc signal in the input and peak the two trimmers while the tuning gang is about half (open or closed, take your pick.)



If you don't own a signal generator, try a BC set tuned to 1445 kc (good about half a mile). Peaking should be sharp but not jumpy. Turn off the signal, and maybe you can do it on noise (I did). Next make the oscillator go. Remember if things are tuned below 26.5 it may decide that 8.8 mc is where to oscillate—be sure it is working properly.

Find the 26.5 juice with a grid dipper coupled to the mixer output tank. Now suck it out by tuning the trap trimmer. To check that the trap tunes (it's easy to get mixed up) take power off, short 6U8 plate to ground and dip the trap coil, which is mounted above chassis. Dip at 26.5 mc-*one* dip. It tunes the same place, almost, with the short off and properly adjusted.

Hooked up to the 75S, the output coil slug can be peaked at 28.3 or 28.4; the rf should be retrimmed on the antenna you're using, and you ought to be in business.

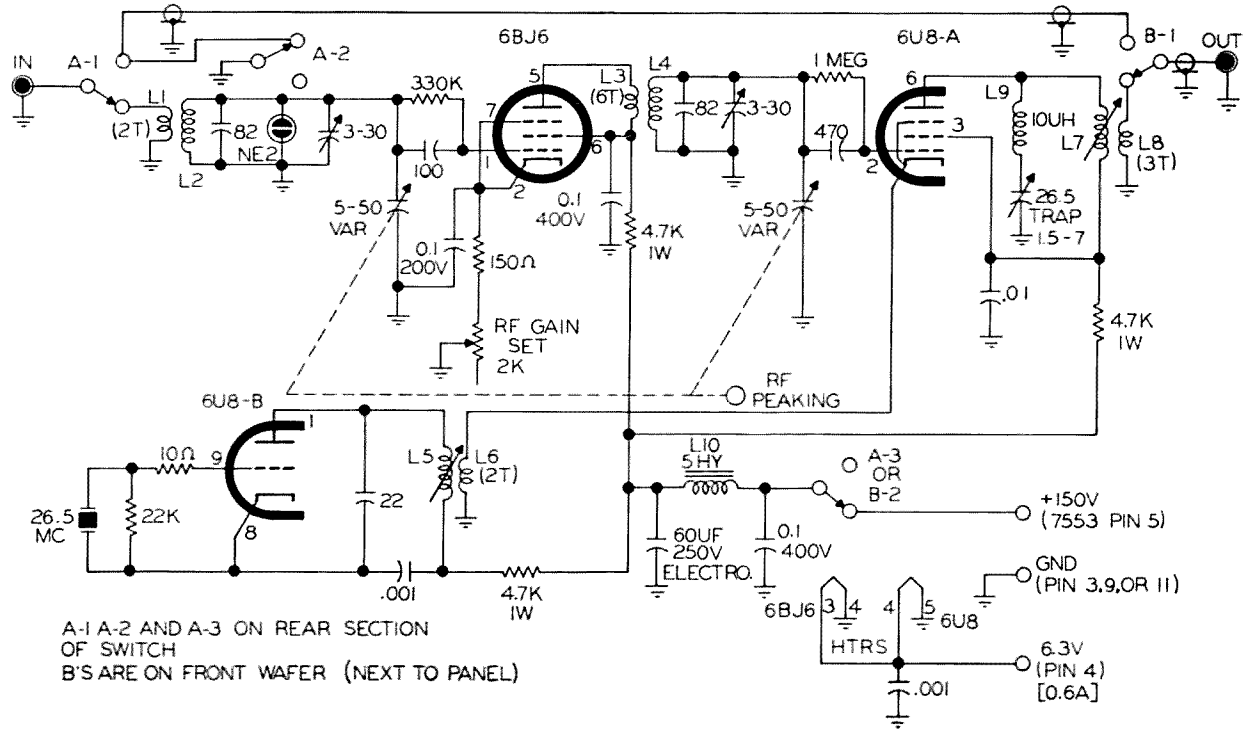
The neon bulb and RC net might save you an antenna coil, as one or two watts can cook it.

73 and good hunting. See you on 432.03 when the long waves start to pall.

. . . W1OOP

Coil Table

L1—Ant. pri. Wound on L2 form, next to pie.
50 ohms 2t. any kind of magnet wire.
300 ohms 5t. as above.
L2—National Co. B-17331 remove 48t. Q=190.
L3—RF plate 6t. wound on L4 form, no. 24 sse or such.
L4—Mixer grid same as L2.
L5—Xtal osc. plate 22t. no. 26 formvar on CTC LS6 form, green slug.
L6—Mixer cathode,, 2t. wound over L5.
L7—Mixer plate, 20t. like L5.
L8—Output link, 3t. wound over L7.
L9—Trap coil National B15976 10 **microhenry** choke. If you can't get above wind your own on ¼-inch plastic rod.
L10—Filter choke. (Stancor C-2318, C-1279, C-1706) 25 ma or more dc. 5 henry or more. 400 ohms or less.
Tuning Condenser—Hammarlund HFD-50 (HFD-100 will work.
In/out switch—Centralab PA-2021 (2 pos., 3 poles used rear section, 1 pole front section). PA-302 index.
Crystal—International Crystal Co. Type FA-9, 26.5 mc.

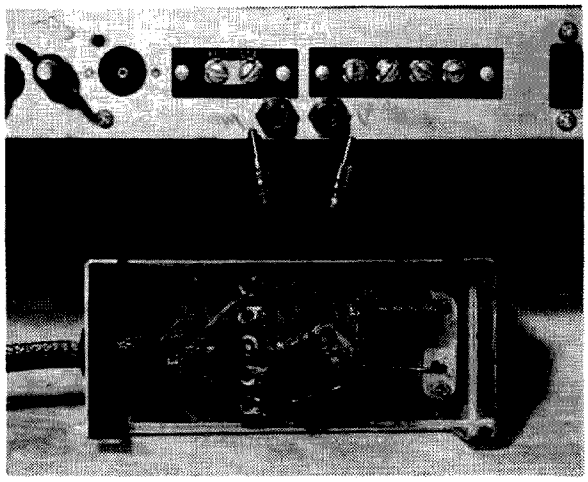


Crystal Control for the GSB–100

Edson B. Snow W2BZN
139 Edgeview Lane
Rochester 18, New York

COMMERCIAL Sideband Exciters like the Gonset GSB100 put out a beautiful CW signals, run at the right input and would be fine for Novice use except for one thing: they have no provision for crystal control.

Modification of this rig for crystal control is not difficult. The trick is to do it without destroying resale value or affecting its normal operation. This precludes extensive internal wiring changes and extra knobs on the front panel. If the modifications can also serve a future purpose, the value of the rig could be enhanced! The following applies specifically to the GSB-100 but probably could be applied to other rigs.

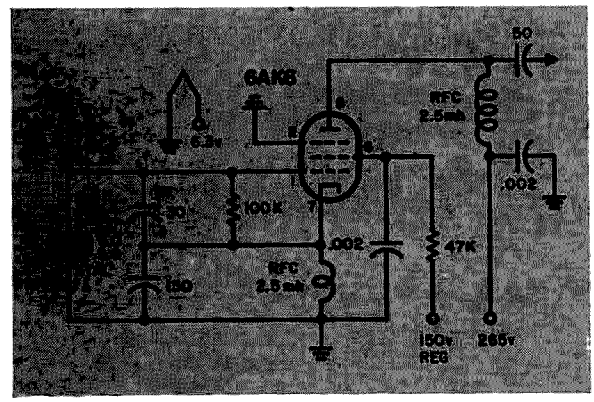


The GSB-100 uses a 12AU7, one half of which is a vfo tuning from 5.0 to 5.6 mc, and the other half a cathode follower. This signal is later mixed with appropriate crystals to give output on all bands. The low impedance output of the cathode follower is led around the chassis to the grid of the mixer via a miniature coax cable. If we cut this coax lead and switch in the output from an external crystal oscillator using cheap surplus crystals in the 5.0 to 5.6 mc range, the GSB-100 will never suspect that it is being crystal controlled. A bonus to this scheme is that one crystal gives output in a number of bands, but do your arithmetic carefully because some combinations land outside a ham band!

Minimum modification of the GSB100 requires the mounting of two phono jacks on the rear apron. Use Switchcraft 3501FP jacks which mount in a single ¼" hole. Locate the holes carefully to clear components on the inside and not to interfere with the replacement of the cabinet. Remove the coax lead that runs from pin 8 of V9 (the vfo tube), to the capacitor C63 which is tied to pin 1 of the mixer tube V5. From each of these points run separate coax leads (Amphenol sub minax type 21-597) to the two jacks that you have just mounted. Leave C63 still in the circuit. Mark the jacks "VFO" and "MIX" respectively so you won't be confused when the rig is buttoned up again. To restore normal operation while you are working on the external gear, make a jumper using two RCA type phono plugs and a short piece of RG59U.

The external gear may be run from its own power supply, but while you have the GBS-100 opened up it is easy to add a socket to steal power. I relocated the grounding bolt and used its hole for a ⅝" socket punch which makes the right size hole to mount an Amphenol #78-S4S socket. This provides the common ground, six volts ac for the filaments, 150 volts regulated, and 275 volts unregulated.

Almost any crystal oscillator that will take a 5 mc crystal will fill the bill. My first model used a 12AU7 as a Pierce oscillator and cathode follower to provide the ultimum of isolation. However, after some experimenting and a little cogitation I settled for the simple grid-plate circuit with untuned output shown in Fig. 1. The output of the VFO to the mixer in normal operation is very small, therefore the crystal substitute can loaf along, with



output to spare. The circuit works with any crystal. There are no tuning adjustments, and the electron coupling in the tube provides good isolation. Even the high impedance output with the coax cable capacity shunting the output still permits adequate drive to the mixer. Even with these losses, the output may still be more than is required. This is easily corrected by increasing the value of the 47K screen resistor. Also note that this oscillator runs continuously as did the VFO.

The unit pictured, was built in a Minibox, 4" x 2⅛" x 1⅝" (Bud 3002A) and used a 6AK6 Tube. This tube was selected because it has a low filament drain, is well screened and because I had one. A 6AH6, a 6CL6, a 5763 and probably several others would work just as well. There is nothing critical about construction or placement of parts.

When Novice days are over, you have the choice of VFO, or crystal for spot frequencies. You have a utility crystal oscillator for many uses around the shack. You can FSK the crystal for RTTY. Also, with the jacks on the back of the GSB100 making it possible to control its frequency from an external source, you might want to investigate the idea of using the VFO in your receiver and a suitable mixer to be able to "tranceive." For example the oscillator in the Drake 1A tunes from 4.0 to 4.6 to cover the same ranges as the GBS100. A couple of tubes and one crystal should do the job!

IMPEDANCE BRIDGE **Complete Instructions (August 1961 issue of 73)**

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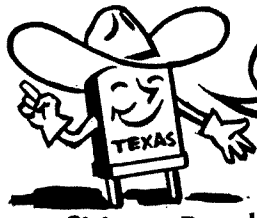
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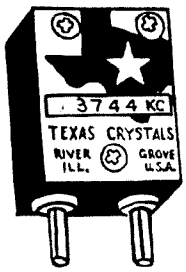
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73 test the Knight CPO

Larry Levy WA2INM

Before you turn to the next article, thinking that since you already have your ticket, what use would you have for a code practice oscillator, I would like to point out that there are many uses that a ham has for one of these versatile gadgets aside from learning the code. The Knight code practice oscillator is a one transistor oscillator powered by a single penlight cell. It has enough output for comfortably driving a pair of headphones and is very useful for learning the code or for increasing your code speed, the use that it is intended for. There are other uses. The kit costs only $3.89, very little for such a useful accessory. The construction takes about ½ hour. There are several large, clear, diagrams which speed up construction, as do the step-by-step instructions.

Besides learning the code, the oscillator can be used for sending *ICW*. It is only necessary to put a 5k resistor across the phone jack and couple the audio into the microphone jack through two .05 condensers (one in each lead). This should help the use of code on VHF where many of the stations have no bfo's in their transceivers and therefore cannot copy a normal CW signal. By using it in the same basic manner, it can be used for an audio signal generator for trouble-shooting modulators and other equipment. It can be used for a monitor and for sending *MCW* by building the following detector. The detector consists of a diode, capacitor, rf choke, and a way of obtaining the proper rf voltage. For high power transmitters, it is only necessary to have a piece of hookup wire near the transmitter (see Fig 1). For lower power rigs, the power should be taken from the coax through resistor "R." Resistor "R" should be determined by placing a 10k resistor across the output and adjusting the output until the voltage is about 1½v. The voltage should be checked even if a wire is used. The battery is removed from the osc. and the detector is connected to where the battery was. Be careful to observe polarity. The key jack is then shorted. Whenever the carrier is turned on, the oscillator will oscillate. The oscillator only requires a few milliwatts so it takes very little power from the transmitter. I'm sure that monitoring will improve the fists of a lot of amateurs and make many more solid contacts. For MCW, connect the oscillator to the detector as for monitoring, but connect the output to the microphone input as in ICW. The carrier is keyed. The oscillator will provide a note to the modulator whenever the carrier is on. This type of emission is useful on VHF during an aurora when you cannot tell if a station is tuning with his BFO on or not.

. . . WA2INM

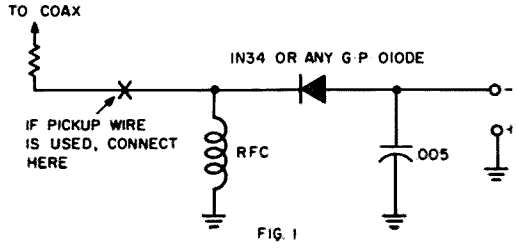


FIG. 1

Audio Filters for Selectivity

It now seems that everybody is getting filter-happy. No wonder, with the bands as crowded as they are. W4THU stirred up a new wave of interest with his article in the March issue, "Cure That Angry Band," starting a run on FL-5 and FL-8 filters. Best price we've seen so far is from S.E.G. Sales, 1306 Bond St., L. A. 15, Calif. FL-5 or FL-8, $2.49 each. So cheap it's unreasonable not to have one or two handy to insert in your receiver audio output lines for added selectivity.

Newcomers to this particular gimmik are astounded to find they can copy signals they never heard before. We old-timers and W-tens knew *that*.

De-chirping the Heath VFO

K6UGT Fred Blechman
14512 Daubert St.
San Fernando, Calif.

THERE are no doubt literally thousands of Heath VF-1 VFO's in use today, and the majority of them are most likely being used with Heath DX-40's. In my case—and I've heard of others with the same problem—the chirp on CW when using the VFO was very noticeable, especially on 10 and 15 meters.

Considering that with the cathode—keyed DX-40 the VFO input voltage would vary about 20 volts from key up to key down, it was not surprising that the VFO chirped. The VR tube in the VFO regulated the screen voltage okay, but the 6AU6 plate voltage shifted enough to cause chirp. One solution to this problem, of course, is to use a separate power supply for the VFO; another approach is to voltage regulate the 6AU6 plate. I elected to do the latter, and it worked out so well that, even on 10 meters, my CW note is very close to crystal quality.

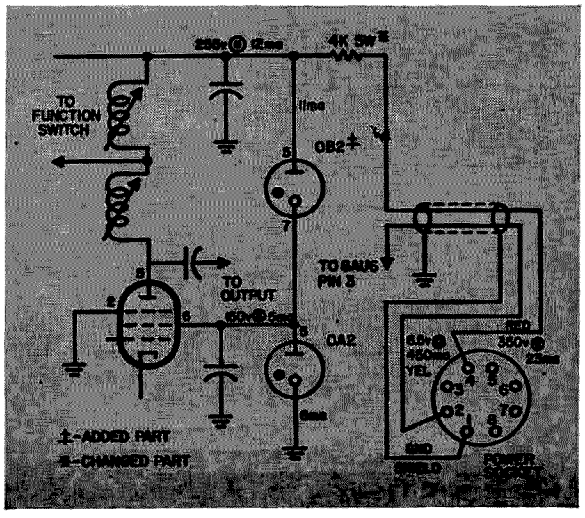
The modification involves the substitution of a resistor, addition of a VR tube, and upping the VFO source voltage to 350 volts (changing one 35¢ resistor in DX-40). See Fig. 1.

All this amounts to is adding an OB2 regulator tube between plate and screen of the 6AU6, and changing the current limiting resistor.

Step-by-step instructions follow:

(1) Remove the 15K 5W resistor from lug #2 of terminal strip J and lug #5 of tube socket B. Put in your junk box.

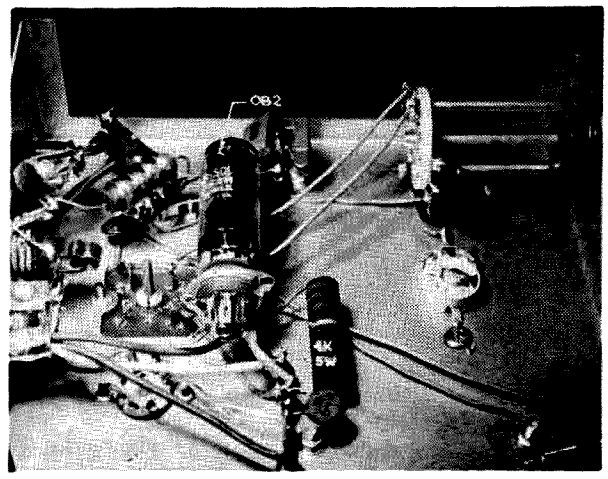
(2) Remove the red power lead from lug #2 of terminal strip J.



(3) Connect one end of a 4K 5W resistor to lug #2 of terminal strip J. Place this resistor in the area between terminal strip J and the ceramic trimmer capacitor.

(4) Solder the red power lead removed from lug #2 of terminal strip J to the free end of the 4K 5W resistor. The resistor lead is stiff enough to support the connection.

(5) Prepare a 7-pin miniature tube socket by soldering a 1-inch long #18 bare wire to lug #5, and a 1½-inch long #18 bare wire to lug #7.



(6) With the new tube socket placed between terminal strip J and tube socket B, and oriented for the new tube to extend horizontally across the underside of the chassis, solder the wire from socket lug #5 to terminal strip J, Lug #2. Use sleeving.

(7) Solder the bare wire from new tube socket lug #7 to lug #5 of tube socket B.

(8) Insert an OB2 Voltage Regulator lead in the new socket, and bend the socket lead wires as required to support the tube.

Make sure the VFO input voltage is increased to about 350 Volts. With a DX-40, this is easy; just replace the resistor attached to pin 4 of the accessory socket with a 10K to 12K 10 watt resistor. The lowered resistance means less voltage drop, and therefore higher voltage at the VFO.

Operate the VFO in the same manner as previously. All switch functions are unchanged. Power consumption is not increased enough to talk about. On phone operation there should be less tendency to FM when modulating the transmitter. . . . K6UGT

modified VOX

Donald W. Bramer K2ISP
45 Thayer Road
Fairport, New York

Break-in CW with the 20-A

IT is possible to operate full break-in CW with your present SSB exciter, providing it incorporates a VOX circuit.

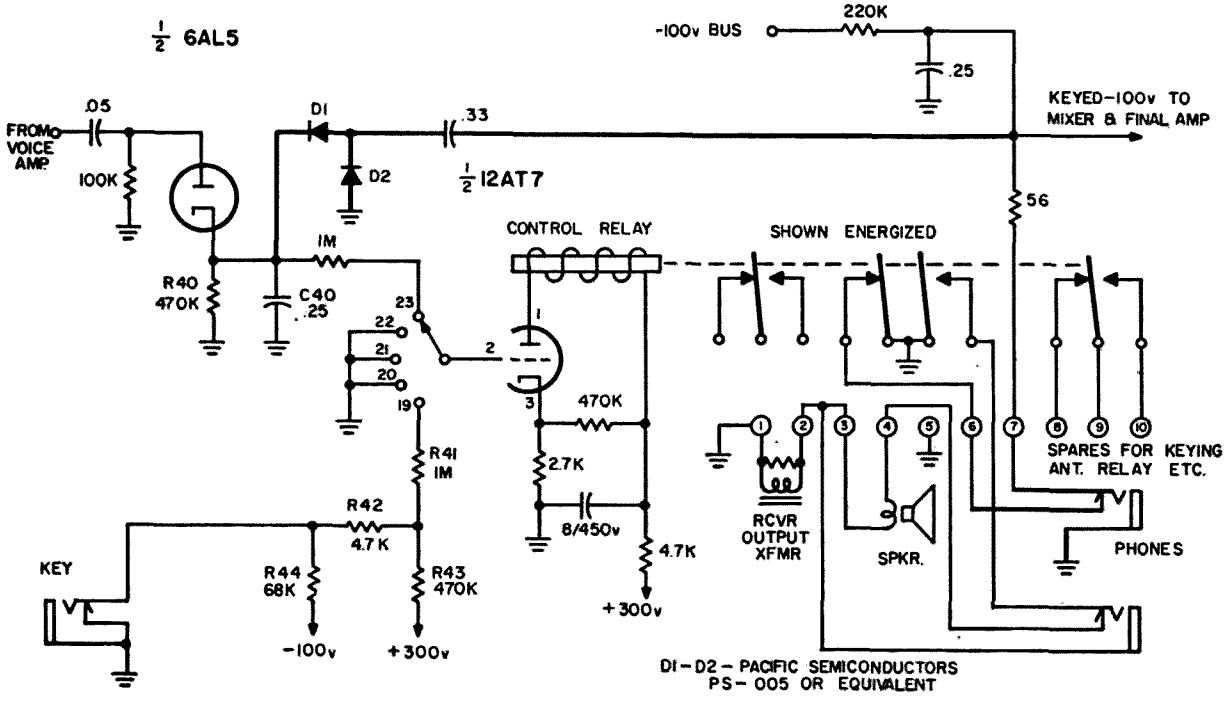
Various systems of voice controlled break-in are in use, but they are all basically the same. Some of the audio from the speech amplifier is amplified again and rectified, and the resultant dc signal is used to key a relay control tube. This high speed relay is in turn used to key one or more stages in the SSB exciter or transmitter, blank the receiver at the time when the signal is on, and also actuate the antenna relay at the appropriate moment. Voice-controlled circuits must have a small amount of "hold" or time constant built into them so that they will hold in between words, but turn on rapidly at the slightest voice signal coming through the speech amplifier.

For operating convenience the voice rectifier time-constant and relay control tube may be utilized, as described below, as an automatic transmitter "turner-onner" for CW. The station switches over to the complete "transmit" condition when the first dot is sent, and holds in as long as the operator maintains about 10 words a minute or faster. The system can be classified as full-break-in in that it permits hearing the other fellow whenever the key is up for more than but a few milli-seconds.

Full break-in operation with excellent keying characteristics is easy to come by if you are a proud owner of a Central Electronics 20-A, but with little imagination the idea might well be applied to the 10-B, SB-10, and other similar exciters. We shall confine our discussion to modification of the 20-A.

In the 20-A, as shown in Fig. 1, one section of a 6AL5 dual diode load resistor, R40, and a .25 mfd capacitor, C40, determines the VOX time constant. The rectified voltage is positive at this point. The other section of the 12AT7 voice amplifier tube is used to operate the VOX relay which in turn keys the transmitter on and off by a grid-block type action. In standby, negative 100 volts is applied to the grids of the mixer and amplifier stages. This voltage also appears at the rear strip, terminal #7, for block biasing any external amplifier. In transmit, this voltage is shorted out to ground by the VOX relay with the operation switch in the manual or VOX position when any small positive voltage from the voice rectifier will trip the relay with the resultant keying of the transmitter.

Additional contact sets are provided on the relay, and are connected to the rear terminal strip. These contacts are usually used to key an antenna change-over relay and mute the receiver when ever the transmitter is "on." Section 2 of the operation selector switch connects the grid of the relay control tube to the positive output of the voice rectifier for VOX operation, or to a voltage divider for manual operation. This divider consists of R42 and



R43, which is connected between plus 300 volts and ground. It furnishes about 30 volts positive through a 1 meg current limiting resistor to the grid of the control tube. When an open key is inserted in the key jack, 30 volts negative appears at the junction of R42 and R43. When the key is closed, the voltage at the junction returns to 30 volts positive. The application of the negative voltage while the key is open provides faster relay release for high speed keying. However, as should be obvious, the VOX relay is actuated with the resultant auxilary antenna change-over and muting, for each and every dot or dash pounded out on the key or bug.

Fig. 1 also shows the relatively simple modifications necessary to incorporate the VOX time constant and relay control circuitry for CW operation while still maintaining its original functions for VOX phone use. Only two diodes, a .33 mfd. capacitor and a few minor wiring changes are required.

The combination of the 6AL5 diode and its time-constant load, R40 and C40, together with the additional diodes D_1 and D_2 and the .33 mfd capacitor form in essence what is known to computer people as an "OR" gate. Simply, the R40 C40 timing circuit may be charged either by voice energy rectified by the 6AL5 diode or by the discharging of the .33 mfd capacitor through D_1 whenever the key is closed.

With no key inserted in the jack, the circuit functions as normal for VOX and Manual operation. In this case transmitter keying is handled as usual through contacts of the control relay.

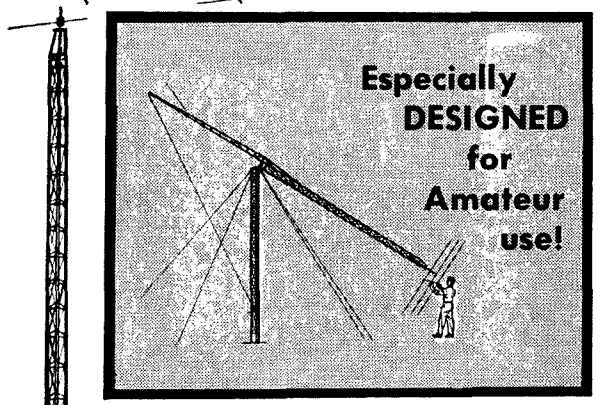
When an open key is inserted, the path through the relay contacts is broken. The .33 mfd capacitor is allowed to charge to the negative 100 volt bias level through diode D_2. When the key is then closed, the stored charge in the capacitor is released through diode D_1, and the charge is thus transferred to the R40/C40 time constant. C40 takes on a good share of the charge previously stored in the .33 mfd coupling capacitor. The new charge on the R40/C40 circuit drives the grid of the control tube positive with the resultant energizing of the relay. The above sequence occurs when the first dot or dash of a transmission is sent and in effect reoccurs for every dot and dash sent for that particular transmission. C40, however, cannot discharge as fast as it can be recharged by successive charging and discharging of the .33 mfd capacitor due to the keying operation. The very low forward resistance of D_2 provides the short charging time constant for the .33 mfd capacitor so that it may receive a new charge between every dot or dash while the high back resistance helps to maintain the necessary energy level required to supply the R40/C40 VOX time constant circuit.

C40, therefore, maintains sufficient positive potential on the grid of the control tube to hold in the control relay as long as a certain minimum code speed of about 10 words per minute is maintained. The relay hold-time together with the minimum code speed requirement may be modified somewhat to suit the operators taste by varying the size of C40. The receiver at the authors QTH is muted by interrupting the speaker line while transmitting. The spare contacts, on terminals 8, 9, and 10 of the rear terminal strip are used to key the antenna change-over relay.

With but a few minutes of actual on-the-air operating, you will be quick to realize the advantages of this type of system.

. . . K2ISP

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Seneca Modulation and Keying

Jerry Vogt WA2GCF
160 Grafton Street
Rochester 21, New York

MANY times when a Seneca user gets on the air someone will remark that the rig sounds good but doesn't have the punch of plate modulation. This is quite true—it isn't quite like plate modulation.

First of all, we must understand that by plate modulation we don't mean basic Heising modulation. We mean regular, run-of-the-mill transformer coupled, plate modulation. We now want to know whether plate modulating the Seneca will be an advantage or disadvantage. Let's consider good and bad points of both plate modulating the Seneca or leaving the rig as the factory recommends—with controlled-carrier screen modulating.

True, with plate modulation you can run a little higher plate current, but not as much as you would for CW operation. Since you are doubling your plate voltage with 100% modulation you cannot run the Seneca at as high a level of plate current as on CW because you would exceed normal plate dissipation by doing so. In practice you can run the 6146's at 140 watts plate modulated, however, many tricks have to be employed such as changing your final plate feed-through capacitor and using forced-air cooling. Heath, however, frowns on this since it still exceeds the published ratings on 6146's in push-pull.

When running the Seneca with plate modulation, you can always watch the average plate current on the meter, which now should remain steady. You would also have an advantage inasmuch as your signal would always be "covering the noise-level" more than with screen modulation that Heath uses. These are a few of the reasons for using external plate modulation. Before running out to buy an Eico modulator let's look at the advantages of playing with the screen modulation Heath says is more practical.

The major reason for leaving the screen modulation alone in the Seneca is probably the best: money. The second reason is almost as good: time and work.

When using the Seneca as is, I have found that it has a certain punch to it that no amount of clipping or speech compression in a plate modulator can deliver. This is due to the fact that you nearly fully modulate the carrier at any instant during the talk cycle. Since the carrier power varies with speech, your voice will cause enough modulation of available carrier at any instant to give "solid modulation" of what power there is instantaneously. Since no form of clipping is employed to get this punch, no distortion occurs as it does when a high level of speech clipping is used. This seems to me to be a definite advantage over plate modulation. This punch is especially useful on aurora openings where the "mush" of the reflection seems to swallow the signal. The punching effect of controlled-carrier modulation will get through when other forms will fail. This can also be seen in single-sideband where the carrier is not important, but where the modulation pulls through because of its punch. A Seneca can be tuned in during an aurora opening the same as a sideband station and the effect is much the same. When a plate modulated station is tuned in this way the carrier is much more steady and therefore the "mush effect" has a greater action on the modulation.

These aren't all the pro's and con's on the subject, but are to be considered seriously before making a decision about it. I have been plate modulating my Seneca for about five months with an Eico model 730 modulator and have gotten excellent reports. I have gone back to screen modulation recently for aurora DX'ing. If you are interested in plate modulating the Seneca, you will be surprised how easy it may be done.

For the CW man on 6, a simple modification on the Seneca will give you better keying. Change the key to key the triode section of the 6AN8 multiplier. This will reduce receiver blocking and reduce the possibility of clamp tube oscillation.

Step-by-step instructions:

Referring to pictorial #15, page 42 of the manual, install a .001 mfd capacitor between lugs #1 and 4 on socket V-9. Next install a

small #6 solder lug under the mounting nut adjacent to lug #4 of the same socket. Place it close to lug 4 and solder. This will prevent the clamp tube oscillation which may have occured.

Remove the lead between pin 7 of V-10 and ground lug on V-11. Install an insulated lead from V-10, pin 7 to terminal strip GG-4.

Referring to pictorial 18, page 52, install a .005 mfd disc capacitor between lugs #1 and 3 on terminal strip DD. Disconnect the negative lead of the 40 mfd capacitor from ground lug GL and reconnect to lug #2 of relay at location K.

These changes will connect the OA2-VR tube and 40 mfd capacitor to the center tap of the low voltage transformer and should reduce receiver blocking.

Referring to pictorial #8, page 20, and pictorial #29, 74, install a .001 mfd feedthrough capacitor in a convenient location near FT-4 so it will not affect the operation of the multiplier bandswitch. Disconnect the ground end of the 1000 ohm resistor coming from pin #3 of the 6AN8 socket and reconnect to the feedthrough capacitor. Connect a lead from other end of feed-through capacitor to FT-7 on driver housing.

This modification should be of definite advantage to the CW man, and if you're an AM man like myself you may wish to perform this operation on your rig just in case some good aurora comes along. . . . WA2GCF

Polaroid Plugs

Unbeknown to many hams who own or use Polaroid cameras, is the fact that many useful objects may be salvaged from a box of Polaroid film. The first item is the container which holds the print coater. This little gem can be used as a coil form or as a container for hardware or non-corrosive liquids. Mounting the tube on a chassis or workbench is accomplished by drilling a small hole through the cap and fastening this to its mounting with a small screw. The print coater itself can be used to coat decals (if you're careful not to press too hard). The empty film reel can also be saved and used as a spacer (up to three and three quarter inches) for open lines, etc. So the next time you finish a roll of Polaroid film save all that "junk," it might come in handy. K2KQJ

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Martin W. Krey K7NZA

How Is Your Ham Image?

THIS IS the age of images, the age of building a special picture in the mind of the public. Keenly intelligent advertising men work hard at this task. President Kennedy is said to be more conscious of his political image than was any other President in history. By a constant effort to appear to advantage, he hopes to retain favor in the public eye. Observant Americans everywhere may well see in the President's example, encouragement to use a little spit and polish on their own personal images. One very prominent politician and former ham operator, Senator Barry Goldwater of Arizona, has taken a step toward alerting the ham fraternity to the significance of its image abroad.

Speaking in Phoenix before the 1961 Southwest District Convention of the ARRL, Senator Goldwater stated that courtesy in DX operating might go a long way toward correcting the distorted, vicious picture that the world has of the United States. We must make a conscious effort to present a good "ham image" every time we go on the air. It stands to reason that if we are sincere in letting hams everywhere know what we are really like, they will want to use our example in judging Americans as a whole.

Since we are on international display every time we press the mike button, regardless of whether or not we are talking to a foreign ham, we should improve our ham image in the area of courtesy. Courtesy was singled out by Senator Goldwater as being the area in which we could spruce up a bit.

Eactly what are we doing wrong? Well, let's look at a few specific complaints that this writer has known hams to make about other hams and about themselves.

One otherwise excellent ham confides that he always tunes his transmitter on any frequency the pointer indicates, just so it's on the band. He honestly admits that he never listens to make sure the frequency is clear. Then when the rig is all tuned, he simply moves to a clear spot to operate. Naturally this creates beautiful heterodynes and makes a shambles of QSO's. Is it courteous? No. Is it fair? No. Does it create a good ham image in the mind of any listener, foreign or American? In a pig's eye!

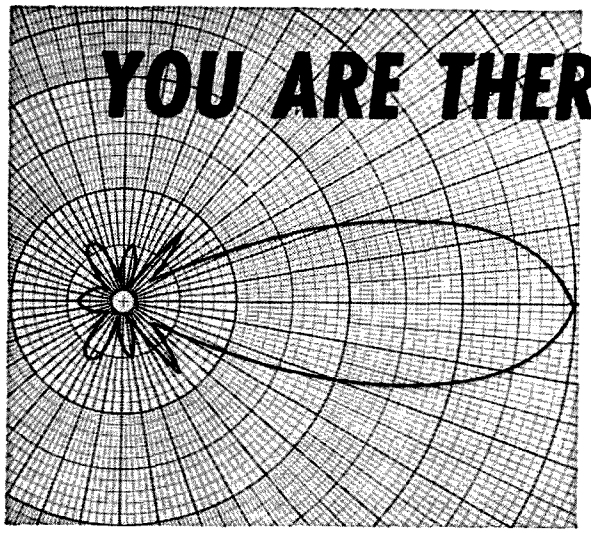
One of the most brazen bits of discourtesy happened to this writer on 20 meters recently. After I had called CQ, a ham in California came back to me and immediately requested that I note my "S" meter. "I'm going to swing the ol' beam around toward Honolulu," he said. "Then you can give me a comparative report off the back end." I provided the comparative report and turned the QSO back to the other ham. He was still pointed toward Honolulu. "O.K. old budy," he said, "and now I'm going to say 73 to you. Gotta get into the Islands." With that he signed out and immediately began calling CQ on my frequency. This treatment still rankles in my brain, as it would in any ham's.

There is an old ham out in the Southwest who is on the air almost daily. He's got a lot of years on him, and he's got his troubles. Sometimes he makes the mistake of unloading vitriol on something or someone who has gone against his hardened grain. Result—people are offended; and before you know it, other hams are on the frequency giving the old spark-gapper a piece of their mind. One ham zeroed in on him one day and spent half an hour carefully timing CW transmissions to the old ham's phone receptions. The old ham went off the air, but not before delivering himself of a barrage of epithets and offensive claims to the point that his adversary didn't even have a window to throw something out of and had brains to match. One could only hope that there were a limited number of foreign and domestic hams on the frequency.

We owe a lot to the shrinking band of old spark-gappers, and when we hear their gravel voices in QSO, we ought to maintain a respectful distance from their frequencies. They make mistakes, but they were surely right on a lot of things way back when ham radio was trying to get certain privileges. Besides, the whole world respects those who show proper regard for age and experience.

Recently an Arizona ham tried without success to make a scheduled contact with a ham in Wisconsin. Every time he finished calling the Wisconsin station, a ham in Indiana answered with a booming signal that dominated the frequency. The Arizona ham ignored this discourtesy several times, but in desperation he finally answered. What did the Indiana ham want? Nothing special. He was just kind of wondering what the weather was like down in Arizona.

Also a problem is the ham who is so anxious to get on the air that he doesn't think of the other hams operating in his immediate vicinity. In my neighborhood, where there are a number of hams within the proverbial stone's throw, we have an unwritten agreement to look out for each other. Time was when it was every man for himself, with no holds barred. I once folded my ear all over the speaker, trying desperately to hear a mobile in Colorado tell what my old home QTH now looked like. But all I heard was the ham next door reading down the list of Joneses in the phone book, trying to find the right one for another ham who had just called in with phone-patch traffic. I asked for numerous repeats through that interminable list of Joneses, but



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finally gave up. I wonder how that ridiculous contest sounded to a ham, say, up in Canada.

Some hams practice the annoying habit of breaking into QSO's during transmissions, and then they pull out and aren't around when asked to identify The practice of breaking helps to give a lot more hams a chance to "get in" on the lower frequencies, but it ought to be done when the frequency has just been turned from one ham to another in the QSO. Also, logic seems to demand that anybody who breaks a QSO be around when the door is opened to let him in.

With the advent of sideband has come still another discourtesy: calling on sideband, a CQ to "anybody on the frequency," and then refusing to answer the AM ham who comes back. One AM operator acknowledges that he responds to every sideband CQ that does not clearly rule him out. If the sidebander ignores him, the AM ham begins a relentless dogging of the sidebander, following him all over the the band on occasion and stopping only when the sidebander answers or gives up. This practice would not appear to have much immediate prestige value to add to the American ham image. The solution is simple: Sidebanders should be specific about whom they will talk to; and AM hams should realize that if a sidebander does not answer them, it is because he forgot to reveal that he was partial to sideband come-backs.

One of the most thoughtless of all hams is the one who fires up the old rig and then settles down to a solid five minutes of calling CQ. Most hams will move off in despair long before he gives them a chance to answer, and so he is impelled by a lack of comebacks to lengthen his CQ'ing on the next crack. This practice effectively ties up a frequency for long periods of time. And does it engender thoughts of admiration in the minds of foreign and domestic hams? Hardly.

The cruelest ham in America is the one who unloads this bombshell: "I don't think we can make a go of it, old man. Either you ain't running much power or your antenna ain't right. I sure can't read you." Then he sometimes adds, "I'm running a full gallon myself. That rig of yours ought to be used on the higher frequencies." This must really turn lights on in the other ham's head—red lights. Particularly if he happens to be in a less fortunate land and has built his rig out of hard-won odds and ends.

We all do a good job of operating, generally; but we all make mistakes. Unfortunately our mistakes are the kind we cannot call back, because they are indelibly printed on another ham's mind. The truth is that the American ham is usually, in nearly all areas of hamming, helpful, thoughtful, generous, and intelligent. How ironic that he is often judged solely on his operating "ham image"!

Bobby Burns, the amorous Highlands poet, once took his arm from around a lassie's waist long enough to observe that if we could see ourselves as others see us, we might change our ways. Although he had some difficulty in following his own advice, it is conceivable that his idea can be for us hams a pretty Scotch way of illuminating that isolated fault that each of us might have. Then we can each polish up our technique, and all of us can take pride in having done our bit to spruce up the American "ham image." And if Senator Goldwater's hunch is right, there could be a corresponding improvement in the attitude of foreign peoples toward our fair country.

. . . K7NZA

Allie Peed, Jr., K2DHA
34 Ashley Drive,
Rochester 20, New York

Calibrate Your Antenna System

STANDING wave ratio instruments are now fairly common items of equipment in ham shacks since there are several good ones on the market at inexpensive prices both in kit form and fully assembled. Since these are passive devices (requiring no power supply) and since most of them can be left in series with the antenna lead at all times, there is a tendency to install them; play with them for a few days; and then, more-or-less ignore them thereafter. Oh, they probably receive an occasional glance to assure that all is well; and if found to be reading excessively high, the average operator will try to find out what's wrong . . . Did one end of the antenna fall down? Did some water get inside the coax? Has wind-whip broken the feed line someplace? But this is the extent of the attention that they will receive in the average operation. They are used, in essence, as a casual sort of "go/no-go" gauge.

This situation is unfortunate because the SWR meter is capable of giving you more information if you'll but take the time to work it out. You probably have all sorts of calibrated devices on your bench—VFO, grid-dip meter, signal generator, frequency meter, etc. —none of which would you feel secure in using without the calibration. Yet, one of the most important parts of your transmitter system is probably totally uncalibrated. This is the antenna system, and your SWR meter is just the gadget that you need to do a calibration job on it over the frequency range covered by your transmitter.



Fig. 1—The Heathkit Reflected Power and SWR Bridge is typical of several such instruments currently on the market.

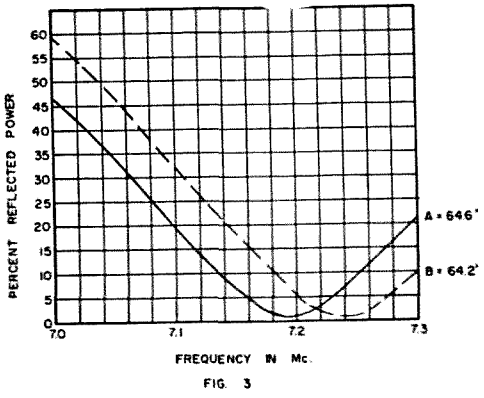


FIG. 3

Fig. 3—Graphical plot of the 40-meter dipole described in the text. Curve A is the performance of the antenna as originally cut. Curve B is the performance after trimming as described.

All that is necessary is a basic understanding of what you want to accomplish here, a working procedure to suit your particular hardware and skywire configuration, and a little time.

Pick an afternoon when there isn't much doing on the bands anyway. In fact, a day when the "bottom has fallen out" is a good one since you will then be causing a minimum of interference to others and you won't be missing any juicy QSO's either. Those sad times when we have a three or four day magnetic storm are fine. On the higher frequency bands you can do your work during times of the day when the bands are closed to all except local traffic.

Fundamentally, all that you are going to do is tune and load your transmitter on a program throughout its full range of coverage in such a way as to get a big-picture view of the system's performance. The data resulting from this investigation you will preserve in graphical form for future easy reference.

This work will go much faster if you will first decide on the frequency ranges that you are going to cover, and the sampling intervals. Then prepare a data sheet which will serve to guide you in your manipulations and also give you a place to *note* your data for later transcription into graphical form. Of course, you can modify this data sheet to suit the frequency ranges which you wish to cover and you may choose different intervals of testing depending on the degree of precision that you wish to have in your curves. Naturally you will work only on those frequencies which are covered by your equipment and authorized by your license. (If you have antennas for only two bands, you won't try to

run curves on other bands. Or if you work only the CW sub-bands you may not wish to run your curves into the 'phone sub-bands. When you are testing in the CW sub-bands, you will be sure that your modulator is off and that you properly identify your test emissions in code.)

A word about recording the data—some SWR meters have both a linear "Percent Reflected Power" scale and a logarithmic SWR scale. For the sake of recording and plotting, the percentage readings are a little easier to use. You can put both scales on your graphical plots and have both types of information even though you originally record only the reflected power data.

In drawing up your data sheets, the following intervals are suggested: For 160, 80, and 40-meter bands, appropriate calibration intervals are 20 or 25 kc. Fuss-budgets might go to 10 kc intervals, but this doubles the work and doesn't give a great deal more information in most cases. For 15 and 20 meters, in-

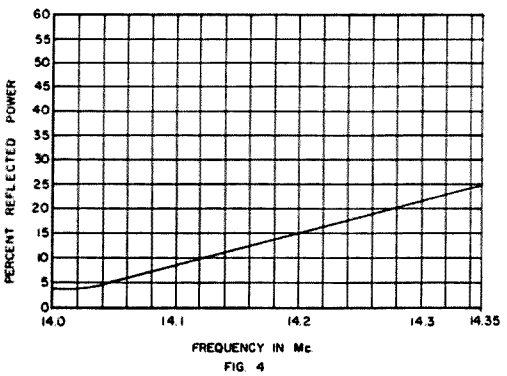


Fig. 4—A 20-meter dipole exhibiting good broad-band characteristics, but too long for optimum performance across the whole band. It should be trimmed to raise the resonant point up into the band for better efficiency across a larger portion of the band.

tervals of 50 kc seem advisable although 20 kc can be used here too if desired. On 10 meters, a 50 kc interval is usually adequate and even 100 kc can be used if your antenna is sufficiently broadband in its response. On the bands above this, 100 kc or even 250 kc intervals may be sufficient. In the course of determining the data, you may find that your antenna has a rather sharply defined resonant dip. If so, it would be well to decrease your frequency intervals on either side of this point in order to arrive at a good resolution of the curve in the vicinity of resonance and thus locate the point of resonance rather precisely. For this reason, when you discover a region of sharply dipping reading on your meter, you'd better decrease your testing interval to half the nominal value and obtain some additional points. You'll need them later when you start plotting the data graphically.

Having drawn up your data sheet, you are ready to begin. Start at one end of the first band and adjust your transmitter for the indicated frequency using the minimum amount of power that you can obtain from your transmitter and still achieve a full-scale deflection on your SWR meter in the forward measuring mode. Calibrate your frequency carefully, preferably using a hetrodyne frequency meter (vis. a BC-221, borrowed for the occasion if possible) or other reliable method of frequency checking which you may have (crystal calibrator, calibrated receiver, etc.). It is important that your frequency readings be reasonably accurate in this testing or your results will not be reliable. When you come to frequencies at the band edges, for safety's sake you may wish to do your testing at a spot 2 or 3 kc inside the band rather than using the exact band edge. Just plot the exact frequency used. You can extrapolate the curve out to the band edge when you are plotting the data later.

After zeroing-in the desired starting frequency, tune the transmitter accordingly and adjust the SWR meter for full-scale deflection in the forward measuring mode. Then, switch to the reverse reading and determine your reflected power or SWR, whichever you have decided to read. Record this on your data sheet. Then note the next test frequency on your data sheet and move the VFO to it. Touch up the rest of the transmitter tuning. Check the adjustment of the SWR meter and make your second reading. Continue through the remainder of your data sheet for the range of frequencies and bands which you have elected to calibrate. (Be sure to change antennas when you change bands if you have separate antennas rather than a multiband array.)

If your antennas are fairly narrowband in their response, you may not wish to run data for the whole amateur band. Establish some

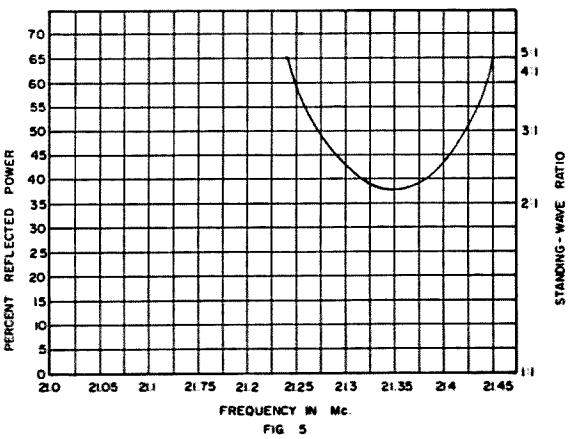


Fig. 5—Third harmonic performance of an inductively loaded 40-meter dipole on 15-meters. Optimum efficiency is not very good since the SWR does not drop below 2:1 at the resonant frequency. This antenna could be used with fair effectiveness only in the 'phone sub-band.

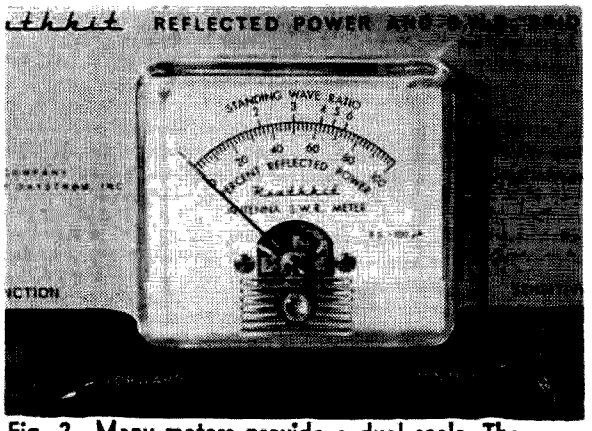


Fig. 2—Many meters provide a dual scale. The linear percentage reflected power readings are easier to read and plot graphically.

arbitrary limit of reflected power or SWR beyond which you would not consider use of the system anyway—say, 75% reflected power, or a SWR of 6:1 for example. When your readings exceed this value, cease your efforts on that band.

Now, with your data neatly tabulated, you are ready to plot the graphs which will give you a picture of your antenna's performance. Obtain some rectangular coordinate graph paper (from a stationery store, drawing supply house, or even the "five-and-dime" store). The type of ruling is of no great consequence. That which has heavily ruled squares of the order of one-quarter to one-half inch on the side with each of these blocks then divided into four or five smaller squares by lighter green or gray lines is quite satisfactory. If you have an ARRL logbook, you'll find one sheet of paper of this type bound into the back of the logbook, and this is a good place to keep your antenna calibration curves. If you wish to put all of your curves on one sheet of paper, it will be best to draw the curves of the different bands in various colors of ink or pencil and use the same color for the corresponding frequency scale along the bottom of the paper for each band.

Having obtained your graph paper, choose a reasonable scale for the band of frequencies of the first band along the horizontal scale of the paper (oriented with the short dimension vertical). For example, if the first band that you wish to plot is 80 meters, you'll have 500 kc to be indicated along the lower horizontal axis. If your particular graph paper has 25 of its large squares along this axis, you might let each of these represent 20 kc. Or, you might decide to use less of the paper, and let 12.5 squares represent the total scale at 40 kc each. Letter in the points on this frequency scale along the horizontal axis.

Next decide on your vertical scale. If you are plotting percent reflected power readings, let each of the larger blocks represent 5% or 10% and carry your scale up to your arbitrary upper limit of 60 or 75%. If you have recorded SWR readings start your vertical scale in the lower left hand corner of the plot with I (not zero) and proceed upward in increments of 0.2 for example to your abitrary limit of 5:1 or 6:1.

When you have established this coordinate framework, it is but a few minutes work to transfer the points from your data sheet to the graph paper. Locate each frequency point and go up vertically from that point until you come to the corresponding percentage point on the vertical scale and make a dot with your pencil. When you have plotted all of these for one band, use a French curve to connect these dots with a smooth curve which conforms to line of dots as nearly as possible.

After you have finished with the first band, draw up a new set of coordinates on a fresh sheet of paper for the next band. Or, if you wish to place all of your curves on one sheet of paper, you can use the same vertical scale for all, but you will have to plot different frequency scales along the horizontal axis and use different colored pencils for the scales and corresponding function lines.

You now have a complete calibration of your antenna system's performance over your total operating spectrum. Thereafter when you wish to band-hop, or operate a contest you can refer to your curves in selecting the frequencies where your system is most efficient. In setting schedules or making decisions to QSY, you can make your frequency selections with assurance of how your rig will perform at the new spot.

If your antenna system is typical, you'll probably find in the course of making these determinations that your system is not performing exactly at optimum. You may find that it favors one end of the band at the expense of the other and perhaps you like to work both ends equally well. Or, you may find that it favors one end when in fact you prefer to work the other end. From the information in the curves, you can determine fairly closely what should be done to optimize the situation and then proceed directly to do it without a lot of guesswork or cut-and-try.

You'll probably be surprised to find that antennas cut by "the formula" when erected under your actual set of conditions do not necessarily perform according to the mathematical predictions. Surrounding objects, height above ground, and similar practical considerations alter the performance over the theoretical ideal conditions assumed by the mathematics.

You can use the data contained in your curves to make some alterations to optimize these conditions. For example, assume that your 40 meter antenna exhibits its lowest SWR at 7.2 mc on your curve. Assume further that you work very little CW on this band, but that you like to work the whole 'phone subband. Obviously, the ideal condition using this

same antenna would be to have it resonate at the middle of the 'phone sub-band so that the SWR is equalized at each end of the sub-band. Assume also that you originally cut the antenna by the formula for 7.25 mc, but that your curves show it to resonate, as previously stated, at 7.2 mc. Obviously, you need to prune this antenna just a bit to raise its resonant point to the middle of the 'phone segment. You can do this without re-measuring your antenna, or any cut-and-try work.

Just use the formula to calculate the electrical length of your existing antenna using the resonant frequency determined from your curve. In the case cited above, subtract this from the actual physical length. This will give you the few inches difference which must be trimmed from your wire. Divide this in half and clip this much from each end of the wire. No need to re-measure the whole antenna.

To make this clear, we'll go through the calculations for the problem outlined above. The antenna was cut originally by this calculation:

$$\text{Length in feet} = 468 \div \text{freq. in mc}$$
$$= 468 \div 7.25$$
$$= 64.6 \text{ feet}$$

The curve indicates that under the conditions of erection and operation it actually resonates at 7.2 mc and thus it acts as if it is electrically the following length:

$$\text{length in feet} = \frac{468}{7.2 \text{ mc}} = 65 \text{ feet.}$$

Thus it performs as if it is too long by:

$$65' - 64.6' = 0.4 \text{ feet or } 4.8\text{-inches}$$

The indications are that we should trim half this amount from each end of the wire—about 2½ inches from each end would probably do the job. Of course, if the situation had been reversed and we wanted to lower the resonant point of the antenna, we would have had to add 2½ inches to each end of the radiators, or cut new radiators to the longer length if there wasn't enough surplus wire in the end-wrap to allow this amount of extension.

You may also find that on some of your plots you really do not have a dip in the curve indicating the location of the resonant point of the system. In these cases, if the curve starts high at one end of the band and generally declines toward the other end, the chances are that the resonant point is actually outside the band beyond the end with the lowest reflected power reading. In such cases, you might do well to shorten or lengthen the antenna slightly (depending on whether resonance appears to be above or below the band) and run a new set of data to see if this moves the resonant point back into the band. Once the resonant point is found, you can then go through the calculations outlined previously to place resonance at the desired spot in the band for your particular operating needs.

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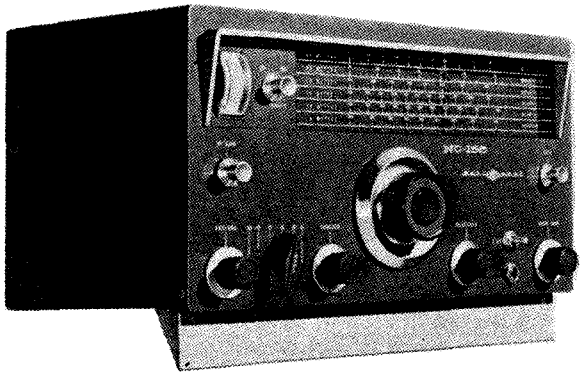
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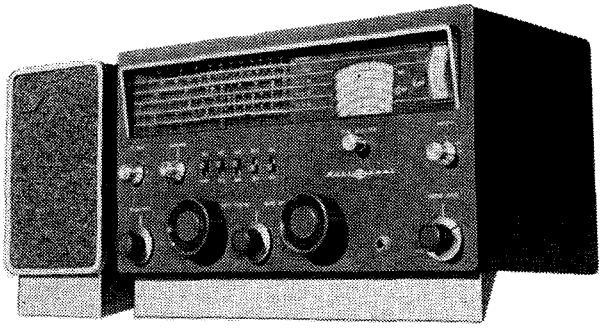
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Staff

A Review of the National NC–155 and the NC–190





Two of the most popular receivers to appear on the ham market in the past few years are National Radio Company's new NC-155 and NC-190. The NC-190 is a double conversion general coverage receiver tuning 540 kc to 30 mc, and the NC-155 is its ham-band-only equivalent covering all amateur bands between 80 and 6 meters. While both receivers are priced at the lower end of the National line, they offer features and performance equal to most receivers of similar types selling in the medium to high price area, and in a couple of instances (which we will take up separately) provide conveniences which are found in no other units that we are aware of.

Both receivers are quite similar in appearance and identical in size. They are both finished in a handsome color combination of dark blue and silver gray, and measure a very compact 8⅝" high, 15⅝" wide and 9" deep. With the exception of front end circuitry, the two receivers are extremely similar electrically (see block diagram Fig. 1). A 6BZ6 is used as a pentode rf amplifier exhibiting semi-remote cut-off characteristics to provide good AVC control and low intermodulation. The 6BE6 first mixer with its self-contained local oscillator converts the signal frequency to the first *if* of 2215 kc. Great care has obviously been taken in the local oscillator portion of the first mixer in both receivers to obtain maximum stability through the use of ceramic coil forms, rigid wiring techniques and the use of a solid ⅛" steel front panel rather than aluminum. The 2215 kc *if* signal moves along to the second 6BE6 mixer and local oscillator combination, where it is converted again to 230 kc and introduced into the Ferrite Filter. This little package, which was first developed by National for use in the well-known NC-270, is composed of ferrite cup cores with Q's of 500 to provide a high degree of selectivity at a relatively high intermediate frequency, thus reducing secondary images. Capacitive coupling between the cup cores is varied to obtain bandwidths of 600 cycles, 3 kc, and 5 kc for CW, SSB, and AM respectively. Coming out of the Ferrite Filter, the signal is fed to two 6BA6 *if* amplifiers also operating at 230 kc after which (depending upon the mode of reception) the signal passes to either a diode AM detector or a triode product detector using one-half of a 12AX7. The other half of the 12AX7 is used as the variable BFO. The triode section of a 6T8 is used for the first stage of audio amplification, and the three diodes available in the 6T8 envelope are used for AM detection, the extremely efficient AM noise limiter, and the clamp to provide delayed AVC operation for maximum sensitivity on weak signals. The audio output from the 6T8 is fed to the grid of the 6CW5 which provides up to one watt of audio at the 3.2 ohm speaker terminals. So much for the circuit description—Now let's see how they work!

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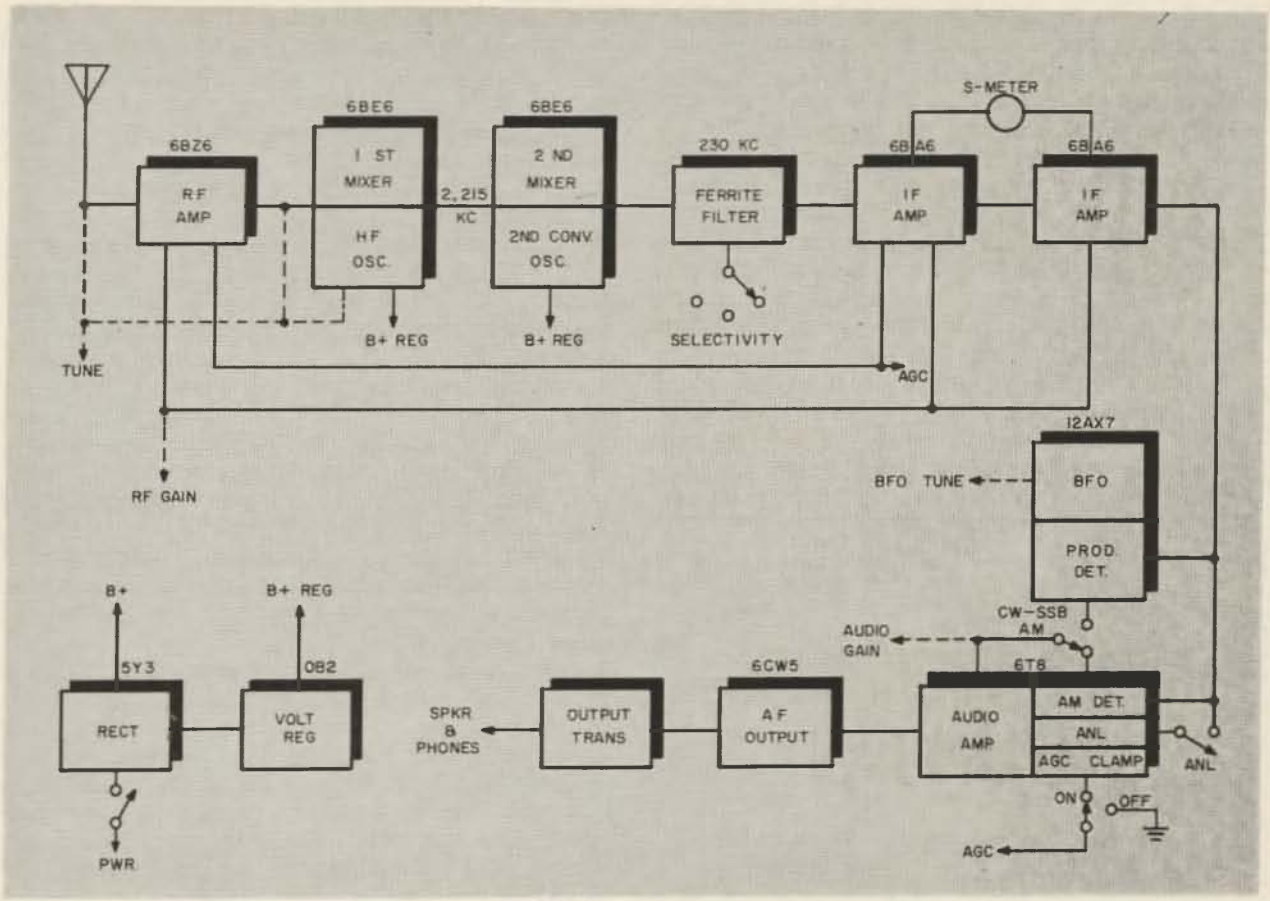
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The NC-190, the general coverage receiver, is a little wonder—This is the first general coverage unit we have laid our hands on (with the exception of some equipment designed primarily for the military in the two kilobuck price region) which handles like a conventional ham-band-only box — Probably the greatest single reason for the "feel" of the NC-190 is the miniature Velvet Vernier employed in the bandspread dial to provide a drive reduction of 60:1—As a result, the tuning ratio of the '190 approximates that of the average ham-band receiver. We understand from National that the planetary drive in question will be soon available as a separate component. We foresee a happy future for this little gadget since it provides a 5:1 reduction in a package the size of an overgrown shaft bushing—Drill one hole, slip in the vernier, tighten up the lock nut and the job is done (if you are wondering how the 60:1 ratio is achieved, the 5:1 vernier drives a 12:1 pinch mechanism—5 x 12 = 60) A shiny little knob under the bandspread scale entitled *Dial Selector* caught our attention as soon as the receiver was unpacked. A quiver with anticipation, we approached the knob carefully, pulled it out a fraction of an inch and rotated it 180 degrees. Lo and behold, a whole new set of bandspread scales appeared in the dial window calibrated for the five most popular foreign broadcast bands! You fellows who occasionally like to listen to foreign broadcast stations finally have a receiver that allows you to locate a station by frequency! Another immediately apparent advantage of the NC-190 is the use of *five* main tuning bands rather than the usual three or four—Thus instead of covering the 10 to 30 mc range in one fell swoop, this range is divided into two 10 mc bands which thereby afford greatly improved calibration and stability (the latter as a result of more efficient temperature compensation over a reduced tuning range).

We operated the NC-190 for approximately two weeks on AM, CW, and SSB. We found the receiver to be remarkably sensitive in all modes of operation (National claims sensitivity better than one microvolt for 10 db), with excellent electrical and mechanical stability. SSB operation is easier than we ever thought possible on a general coverage receiver, and this is accounted for in large part by the very high tuning ratio together with the excellent product detector and SSB/CW AGC system. Sideband selection is by means of a USB/LSB calibrated BFO control, which takes the guess-work out of properly setting the BFO for proper reception. CW performance was excellent, and with the Ferrite Filter set in the 600 cycle position, single signal CW reception was easily attained.

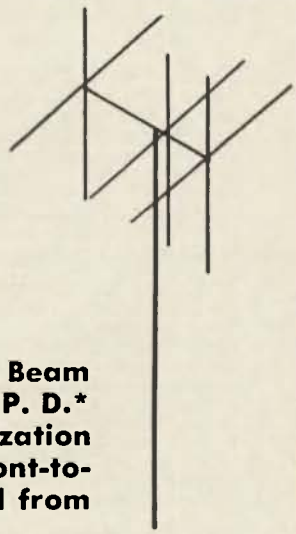
In summary, the NC-190 offers a surprising amount of performance for 220 bucks, and seems to us to be an ideal receiver for the



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ham who wants excellent ham band performance along with general coverage at a relatively low price. We forsee a couple of other areas where the NC-190 will be quite popular —as a general coverage stand-by receiver for the snazzy ham-band-only shack and as a tunable *if* for some of the new VHF converters—The combination of price and performance on this package is hard to beat!

The trial of the ham-band-only NC-155 was viewed with some trepidation in view of the $199 price tag. Twenty-five years ago it was possible to buy an awful lot of receiver for this kind of money, but the cost of labor and materials has risen to the point where it takes around $250 to start getting the kind of performance necessary for today's more sophisticated operation. We were, therefore, prepared to be disappointed in the NC-155 even in view of its handsome appearance and high quality of finish and construction. This feeling began to be dispelled as soon as we laid a hand on the main tuning dial, and by the end of our first forty-five minute session with the NC-155 our original opinion was completely replaced by the happy conclusion that the NC-155 was more than able to hold its own in far higher priced company! Just as in the NC-190, the first operating feature noticed was the extraordinarily smooth tuning mechanism. The NC-155 also uses a 60:1 dial reduction, and the combination of the heavy flywheel on the tuning dial and the Velvet Vernier in a ham-band-only receiver results in a "feel" which closely approaches that of our own NC303. According to National, the 60:1 reduction on the NC-155 is almost twice as high as that of any other ham-band-only receiver, and as a result it is possible to work in on sideband almost as easily as AM (advanced modulation). Dial calibration and illumination is excellent, and electrical features are basically the same as those of the NC-190 since both receivers are almost identical from the first mixer back to the loudspeaker. The NC-155 seems to be as mechanically stable as any receiver we have yet tried with a crystal-controlled front end—We tuned in a relatively strong CW signal on 20 meters, picked the front of the receiver up three inches and let go—There was a slight microphonic bong when the Flip Foot crashed on the tabletop, but the receiver had apparently not shifted a cycle. Electrical stability was almost as impressive—Total observed drift over a four to five hour period from a cold start on 15 meters was in the order of 1 kc.

Six meter stability was naturally not nearly as good, but sensitivity on this band certainly exceeded our expectations—National claims six meter sensitivity better than one microvolt for 10 db, and while we did not actually measure sensitivity, the '155 dug up all the weak ones and had enough hop in the front end to show an appreciable decrease in noise when the antenna was replaced with a 50 ohm resistor. Six meter signals were quite easy to tune as a result of the excellent dial ratio, and we are presently toying with the possibility of using the six meter range on the '155 as a tunable *if* for 2 and 1¼ meter converters because of its complete 4 mc coverage and excellent performance.

Both the NC-155 and NC-190 fill big holes in the current crop of receivers.

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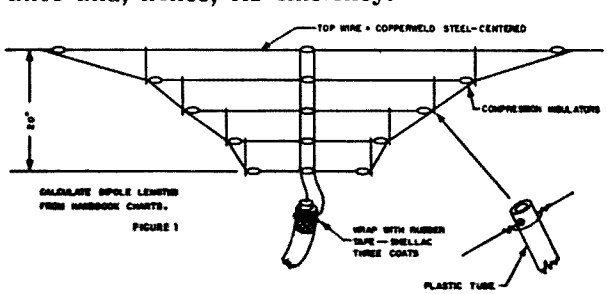
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THE key to good hamming is a good station setup, and this is a lot easier to achieve than you may think. Whether you are trying to decide how to set up the new h-f station or have been operating for a while but aren't getting out like you should, this article is for you.

For all the sour-grapes balderdash one hears on the bands about system-engineered ham equipment, the idea is perfectly sound: each part of the system must work properly with at least one other part. If we investigate this working-together concept more closely, however, we find that such a system really is just a number of "twosomes." For example, the following twosomes will be found in any amateur station: space-antenna, antenna-feedline; feedline-transmitter; and feedline-receiver. It makes no difference whether they are made to work together at a factory or you make them work with ingenuity and hot solder.

In fact, it is because of these twosomes, or "interfaces," as they are properly called, that it is easy to set up an amateur station properly and at low cost. It isn't necessary to perform a set of simultaneous equations in a half-dozen unknowns, but on the other hand, a station cannot be set up just one part at a time. (Can you imagine only one connector connecting?)

In general, the antenna, especially the high-current, center portion, should be as high as possible. There are several reasons for this. The higher the antenna is above the average terrain, the lower (and better for d-x) will be the minimum usable radiation angle. The higher the antenna is above trees and other conducting objects, the less power they will absorb during both transmission and reception. The higher (up to a point) an antenna is above ground, the higher will be its radiation resistance and, hence, its efficiency.



Horizontal, half-wave dipoles usually are used on the h-f bands, primarily because, dollar for dollar, their simplicity and light weight permit them to be erected at greater heights than any other antenna. To be sure, the low radiation angles of vertical antennas are ideal for DX work; but efficient vertical h-f antennas are cumbersome and difficult to erect, they are more vulnerable to man-made noise, and unless a good artificial ground is constructed for them a prohibitive amount of power will be lost in the earth.

A widely-held, somewhat erroneous idea is that the user of a horizontal antenna can communicate in only two general directions, because the horizontal radiation pattern of a horizontal dipole is two lobes at right angles to the antenna wire. But what about the vertical radiation pattern?

It should be remembered that from a horizontal doublet, only part of the total energy is radiated broadside to the wire and that the polarity-versus-amplitude of the energy radiated in any direction depends on both the elevation angle and the azimuth considered. Much of the energy is radiated from a horizontal dipole in line with the wire, or "off the ends." This energy will be received just as well by an antenna the end of which is toward the transmitting antenna as will the energy radiated at right angles be received by an antenna which is broadside to the transmitting antenna. This vertically-polarized energy is radiated at somewhat high radiation angles; but the only shortcoming of the end-radiated rf is that the skip, or maximum range of communication will be somewhat shorter than that for the horizontally-polarized energy from the same antenna.

It is relatively easy to work all bands, from 3.5 to 29.7 mc, with only one feedline if single-wire, center-fed, half-wave dipoles are used. The dipoles are merely cut to the proper length and connected together as shown in Fig. 1. Most of the amateurs who use this multi-dipole antenna system do not include a dipole for the 15-Meter band, because the 40-Meter dipole will load up fairly well on 15 Meters. However, the radiation pattern thus produced contains several narrow lobes instead of the two wider lobes characteristic of a half-wave dipole when operated on its resonant frequency. The

author once used one of these multi-dipole antenna in which a 15-Meter dipole was omitted; operation was excellent on all bands except 5-Meters, until a 15-Meter dipole was added. The new dipole really made a difference, and the author heartily recommends that it be included.

While the impedance of a half-wave dipole may be about 72 ohms in free space, it varies considerably at the heights amateurs have to work with. Most amateurs should be familiar with the standard graph of theoretical antenna impedance (for a half-wave dipole) versus height above perfect ground. The graph also is fairly accurate for heights of more than 0.3 wavelength above "real" ground level. However, it gives no indication of what the actual impedance of a dipole over "real" ground may be for lower heights, because the impedance is shown to approach zero as the height of the antenna approaches zero.

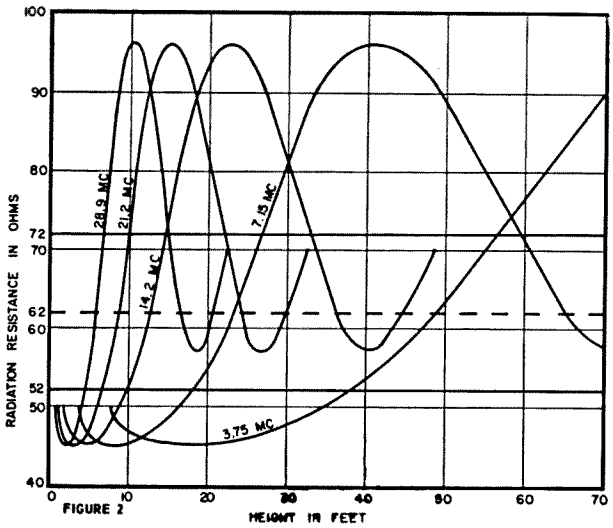


FIGURE 2

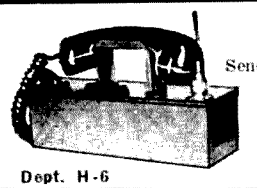
Actual measurements* over "real" ground, however, have shown that the antenna impedance falls no lower than about 45 ohms at 0.06 wavelength (16 feet at 3.75 mc), and in fact begins to rise quite rapidly as antenna height decreases further. Fig. 2 shows the antenna impedances to be expected on the h-f bands for heights up to 70 feet or 0.7 wavelength, whichever is lower for a particular band.

Of course, the depth of electrical ground below "real" ground level will vary from location to location, and thus will affect the accuracy of Fig. 2. It should be remembered, however, that electrical ground usually is no more than a few feet below "real" ground at 30 mc, and less than 10 feet below "real" ground at 3.5 mc. Thus, the accuracy of the graph will vary only slightly for different locations, probably not enough to be detectable.

Amateurs usually use either 52- or 72-ohm coax or 72-ohm twin-lead to feed half-wave dipoles. Referring to Figure 2, the dashed line represents 62 ohms, or half-way between 52

*Henny, Keith. **Radio Engineering Handbook**, Fourth Edition, 1950, McGraw-Hill, page 635 (graph).

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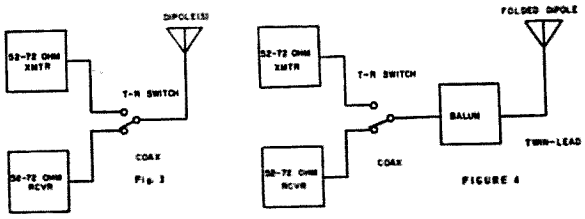
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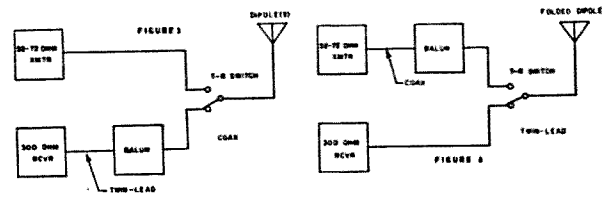
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ohms and 72 ohms. The closer the impedance of the feedline matches the impedance of the antenna, the more power will be transferred between the antenna and the feedline, and the lower will be the standing wave ratio. Therefore, if the impedance of an antenna (as determined from Fig. 2) will be higher than 62 ohms, it should be fed with 72-ohm twin-lead or coax. If the impedance will be lower than 62 ohms, the antenna should be fed with 52 ohm coax.

Just as maximum power will be transferred between the feedline and the antenna if the impedances are the same, maximum power will be transferred between the feedline and the transmitter or receiver if the feedline impedance is the same as that of the transmitter or receiver.

Before the days of pi-output circuits, transmitters usually were link-coupled to the feedlines, if feedlines were used at all. The impedance or the link didn't matter much, because the coupling of the link to the final tank coil could be changed to compensate for wide ranges of link-feedline impedance mismatches. Receivers had all kinds of input impedances; each manufacturer apparently threw dice or else counted tea leaves, which was about all that could be done anyway because there were no standard impedances at the time. Standing waves could stand until they got tired, and open-wire feeders were the thing. Those were the days of the universal, indispensable antenna coupler.



Today, however, the impedances most often encountered in amateur installations are 52, 72, and 300 ohms. With only these three impedances to match, amateurs now can use baluns instead of antenna couplers. Unlike the antenna coupler, the balun never requires retuning, so it can be tucked up out of the way and forgotten. Even more important, however, is that with only three values of impedance to match, four basic systems may be designed, one of which is almost sure to satisfy the requirements of your equipment and antenna. A description of these four systems follows.

Fig. 3 shows a system in which the transmitter output impedance is either 52 or 72

Heath SB-10 on Six

Captain George M. Hunt W4NUT/Mm

1218 SW 21 St. Court Fort Lauderdale, Florida

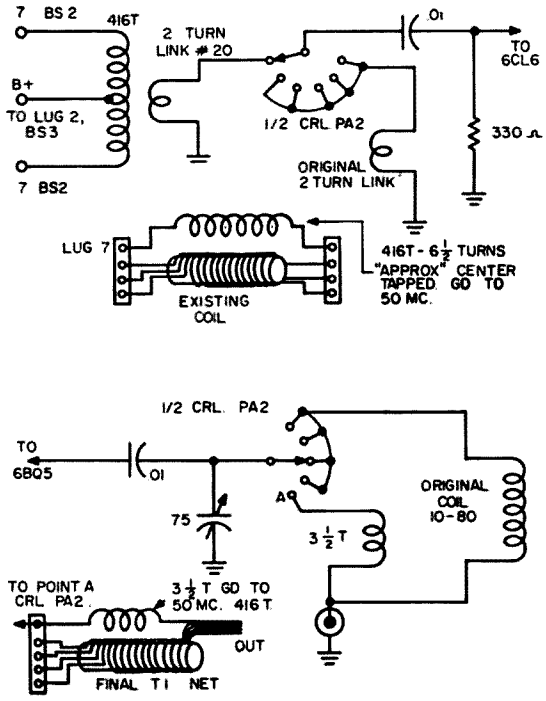
Being a VHF addict, I recently purchased a SB-10 from Heath for the express purpose of putting this phasing type Single Sideband Adapter on 6 meters. The object was to use it in conjunction with the Heath VHF 1 "Seneca." Using the 50 mc drive from the Seneca, converting to single sideband with the SB-10, then driving either the Seneca final in AB or other linear that would require no more than 8 watts of drive.

The operation was successful, the SB-10 works as intended, 50 mc sideband driven from the Seneca. The SB-10 conversion is as follows. Disconnect the 10 meter section of the adapter, and insert 6 meter coil sections outboard of the existing coils, using the wafer switch points formerly used for 10 meters. Add one more ceramic wafer switch to the existing stack, replace the 110 mmfd 1% micas in the phasing stack with a matched pair of 68 mmfd silvers. Remove 3 turns from the 10 meter slug tuned coil, feed three watts of 50 mc drive and 8 watts PEP 50 mc single sideband, upper, or lower comes out the back end. Easier than hetrodyning, no mixers, just tune as per the SB-10 instructions.

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ohms, the receiver impedance is 52 or 72 ohms, and the antenna is either a dipole or a multi-dipole system. Although it is the simplest system possible, it also is the best, because everything except the antenna is shielded by the outer conductor of the coax (keeping spurious radiation in and noise out). Incidentally, coax (unbalanced) feed is just as good as twin-lead (balanced) for h-f work; feeding a balanced antenna with coax becomes a problem only when the diameter of the coax becomes more than a small fraction of a wavelength.

Fig. 4 shows a 52- or 72-ohm receiver and transmitter used with a balun and 300-ohm twin-lead for feeding a folded dipole. Notice that the balun, which matches the receiver and transmitter to the 300-ohm line, is on the antenna side of the T-R switch, and it must carry the output power of the transmitter.

Figure 5 shows a 52- or 72-ohm transmitter used with a 300-ohm receiver and either a dipole or multi-dipole antenna. In this system, the balun is placed between the receiver and the T-R switch, and thus does not carry appreciable power.

Fig. 6 shows a 52- or 72-ohm transmitter and a 300-ohm receiver used with 300-ohm twin-lead and a folded dipole. In this system, an open relay or switch may be used.

In summary, if your equipment is in good operating condition, and if all connections are made properly, a very satisfactory amateur station can be assembled if the following suggestions are heeded:

(1) Place the antenna as high in the air as possible.

(2) Use horizontal, half-wave, center-fed antenna(s).

(3) Select the feedline impedance on the basis of the antenna impedance.

(4) Use a balun to match impedances.

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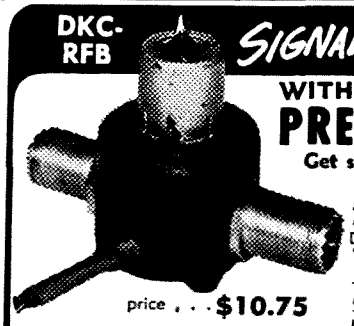
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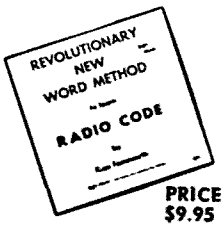
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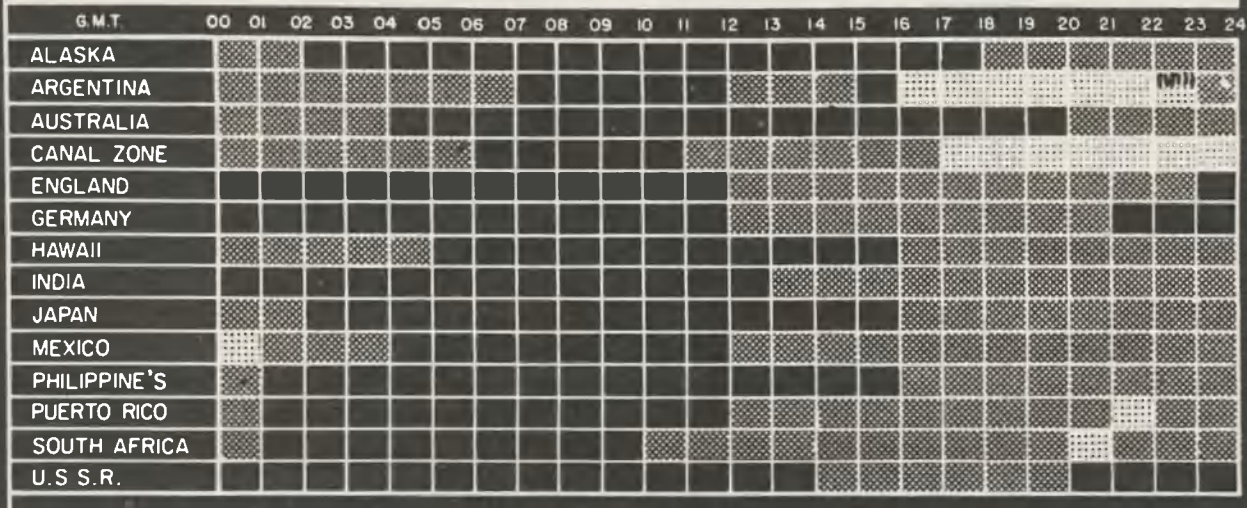
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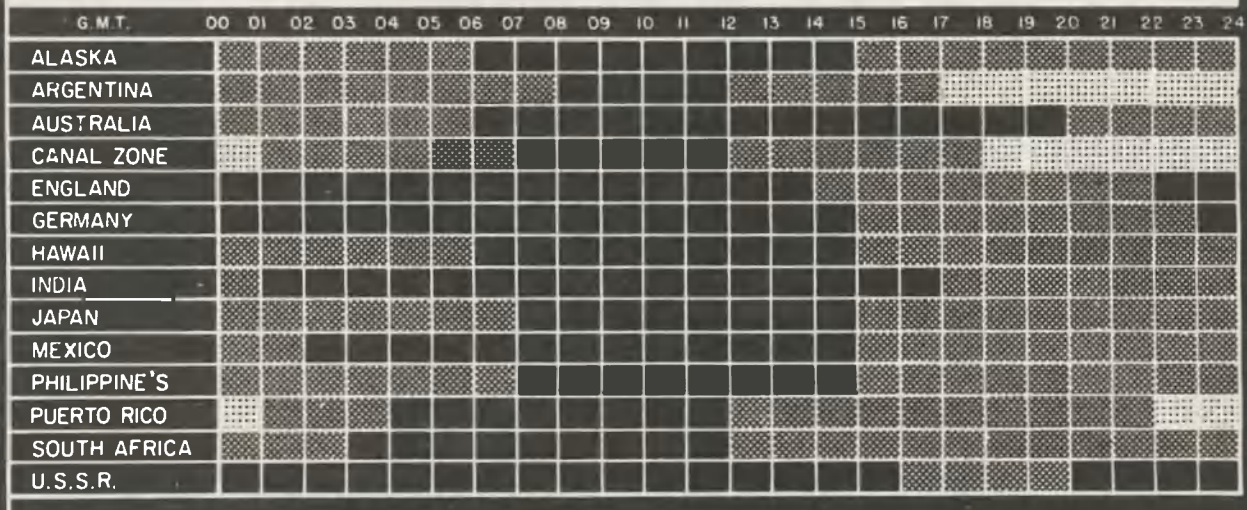
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PROPAGATION CHART

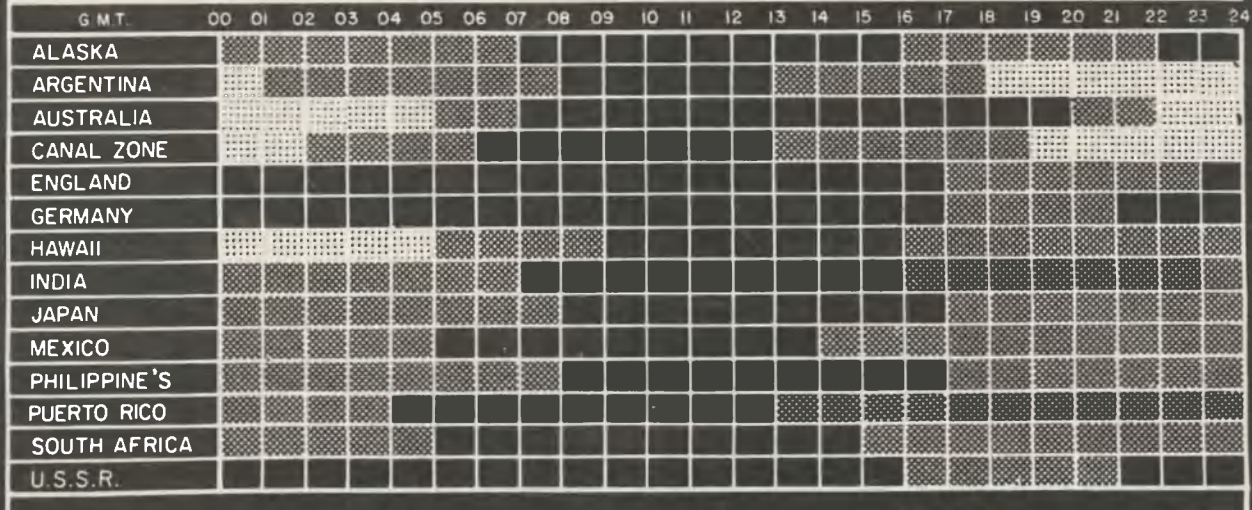
EASTERN UNITED STATES TO



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Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

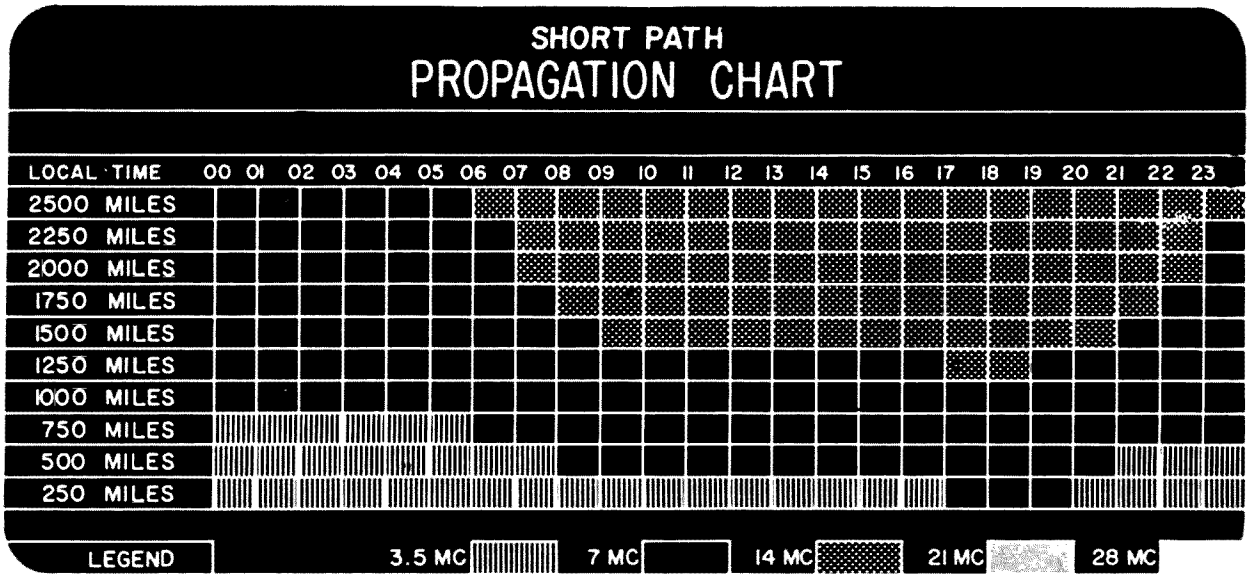
The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

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Fair: 5-6, 25

Bad: 1-4



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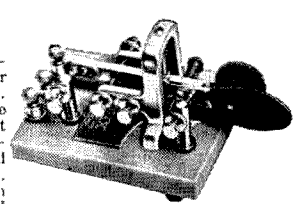
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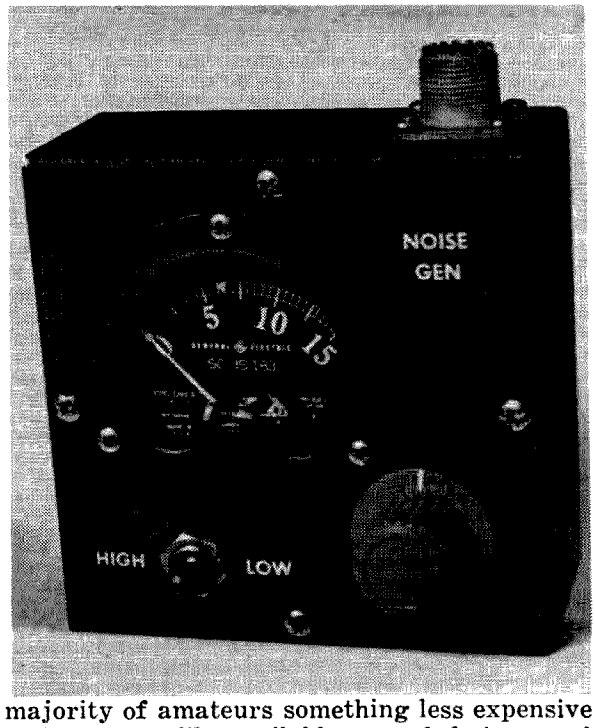
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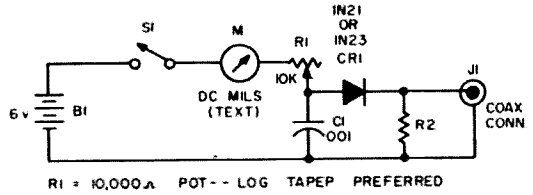
Construction and Use

Karl Tipple W5TEV
Dept. of Electrical Engr.
Southern Methodist Univ.
Dallas, Texas



MOST amateurs who do very much operating at the higher frequencies where receiver sensitivity rather than QRM often determines success eventually come to the conclusion that their present receiving equipment is not as sensitive as would be desirable and that a change is in order. And once that change has been made, whether it takes the form of a new converter or modification of existing rf stages, one nearly always wonders whether the new really *is* better than the old. Comparisons of signal strength with new and old equipment are erratic and unreliable at best and do not necessarily give the desired information since the absolute output level or "S" meter reading is not the problem. What is actually of concern is whether the signal to noise ratio of the receiving system has been improved. Or in other words, does a given rf signal produce an audio output signal from the new receiving equipment that is louder in comparison to the background noise than did the same input signal with the original receiving equipment. If it does, the noise figure of the new receiving equipment is smaller (better) and it should be possible to copy a weaker signal than before.

Unfortunately few of us own or have access to a signal generator of the proper frequency range, with an accurately calibrated attenuator and shielded output, for making the type of measurements mentioned above. For the majority of amateurs something less expensive and more readily available is needed. A crystal noise generator, which can be constructed for a few dollars and which will enable anyone to make before and after comparisons of noise figure, is such a device.



R1 = 10,000Ω POT-- LOG TAPEP PREFERRED
R2 = 1/2 WATT NON-INDUCTIVE RESISTOR EQUAL TO LINE IMPEDANCE

FIG. 1

Briefly, the theory behind the use of the noise generator follows. The sensitivity of a receiver is highly dependent on the ability of the rf stages to amplify a weak signal as much as possible while adding a minimum amount of noise to the signal. Noise of this type will be heard at the receiver output as a familiar hiss or "rushing" sound. Now, if an external source of broadband or white noise (random noise independent of frequency) is connected to the receiver antenna terminals, an increase in noise or hiss will be noted at the receiver output. And if the noise generator output is adjusted to provide exactly twice as much receiver output noise as existed before the application of the noise generator, then the generator must be providing a noise signal equal to that generated in the receiver. Thus, if the receiver can be modified so as to reduce the noise generator signal required to double the receiver noise output, the noise figure of the receiver will have been improved.

A noise generator of the type described in this article can not be used for measurement of absolute noise figure without additional calibrating equipment. It can, however, be used for *comparison* of noise figures. It enables one to determine whether a receiver really has been improved and it can be used to determine which of a number of possible modifications will yield the best results in terms of minimum noise figure (maximum sensitivity). Use of the device will be discussed in more detail later.

A basic noise generator circuit is shown in Fig. 1. The noise is produced by CR1, a silicon

diode of the 1N21 or 1N23 variety. These diodes have been widely available on the surplus market for several years. They are also readily available new at small cost; however as will be explained later, it may be desirable to use a surplus diode rather than a new one.

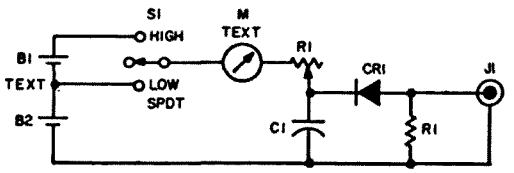


FIG. 2

R1 = 10,000 ohm pot—log taper preferred
R2 = ½ watt non inductive resistor equal to line impedance
Other parts same as Fig. 1

The current supplied to the diode from the battery and therefore the noise generated by the diode is determined by the setting of R1. The best value for R1 is necessarily a compromise since in its maximum resistance position it must limit the current to a low value but it must also not change resistance too rapidly at the low resistance end of the range or the normal operating range of the instrument will be limited to only a few degrees rotation of the R1 shaft. A 10,000 ohm log taper pot should prove satisfactory.

The value of R2 should be about the same as the transmission line impedance. A good value might be 56 or 68 ohms, although if it is desired to use the noise generator with equipment which normally operates from higher impedance lines, a larger value should be selected for R2. In this case one might compromise with a value of 100 ohms. C1 serves as bypass capacitor and may be either mica or disc ceramic.

A more elaborate arrangement was used in the construction of the unit shown in Photo. 3. A schematic of this generator appears in Fig. 2. Here a tapped battery (2 pencells) was used to minimize the range to be covered by R1. It should also be noted that the diode is shown reverse biased in Fig. 2. Many of the surplus diodes available have very poor reverse resistances, which will allow reverse bias operation, and when operated under these conditions will generate considerably more noise for the same bias current than when operated in the more conventional configuration shown in Fig. 1. The diode must have a reverse resistance of only a few thousand ohms or less if it is to work successfully in the reverse bias connection. Therefore unless the reader can obtain some surplus diodes and select one with a low reverse resistance, it will probably be necessary to operate the diode forward biased and to use the higher battery voltage of Fig. 1.

The meter range depends upon the battery voltage and the resistance of the diode in whichever connection it is used. The meter used in Fig. 2 was a 0-4 ma surplus meter. However, if the diode is operated in the forward biased connection a meter of somewhat higher current rating will probably be needed. Therefore, it is suggested that a low range meter be obtained and if more than full scale current is required for the diode to develop sufficient noise, a shunt resistance can be placed across the meter terminals to extend the meter range. An inexpensive meter can be used since all that is needed is a relative indication of current.

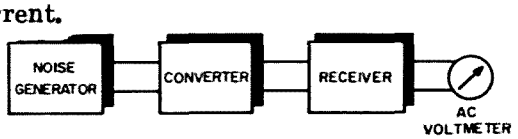
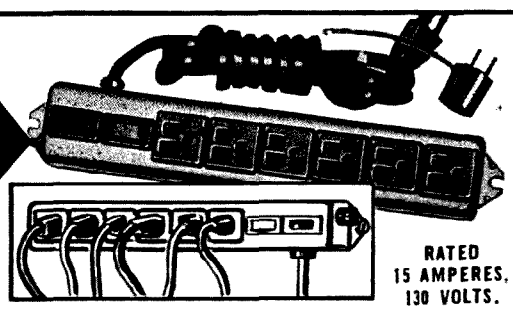


FIG. 3

For those not familiar with the IN21-1N23 type diodes it might be mentioned that they have no wire leads. The anode connection is a brass shell on one end of the unit and the cathode connection is a brass pin at the other end. Although external connecting wires might be soldered to the brass ends, there is danger that the diode will be over heated and destroyed by such techniques. It is safer to make connections by clamps made from small plate or grid caps or fahnstock clips.

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It should be evident from the above discussion that there is nothing critical about the construction of a noise generator of this kind and that a number of different circuit variations are possible. Even if the device were constructed entirely of new components the cost should be less than $8 and with a little ingenuity the cost can be reduced substantially through the use of surplus parts.

Perhaps use of the noise generator can best be illustrated by considering an example of noise generator application. Suppose that you want to use either one of two available 6 meter converters with your low band receiver and that you wish to determine which converter will provide the best weak signal reception. A test set-up is shown in Fig. 3.

The ac voltmeter is used to measure the audio output of the receiver and may be either a multimeter or a VTVM. It can be connected across the speaker terminals or across the headphone line. Higher voltages can generally be obtained from the headphone output and this connection will probably have to be used if a multimeter without a very low ac range is used.

The measurements can be started by measuring the ac noise output voltage from the receiver with the noise generator turned "off". Then the noise generator should be turned "on" and the generator level adjusted until the output meter reading has doubled. At this point a note should be made of the noise generator setting. The above procedure can now be repeated with the second converter connected to the receiver. Whichever receiver-converter combination requires the smaller noise generator current setting to double the noise output is the combination that will provide the best weak signal reception.

The noise passed by the receiver is a function of the bandwidth of the receiver. Also the reading given by a particular output meter is dependent on its bandwidth. Therefore the bandwidth of the receiver should not be changed during measurements and the same output meter should be used thoughout a set of measurements.

The technique described above can also be used to determine which of a number of rf amplifier tubes will give the best performance. The noise generator can be used for alignment of rf stages.

For the man who constructs his own converters or receivers the device is a tremendous boon since such adjustments as determining the optimum antenna to grid coil coupling can be made simply by adjusting for maximum increase in noise when the generator is switched "on". (This technique gives the same results as adjusting for minimum noise generator setting to double noise output and it is a bit easier to use when adjustments must be made.) If the input circuit uses a single tapped coil instead of two coils, the best tap position can be determined.

The uses mentioned above are only a few of the possible applications of this noise generator, and for the amateur who constructs his own receiving equipment the device is indispensable. . . . W5TEV

REFERENCES

Ionospheric Radio Propagation, National Bureau of Standards Circular 462, June 25, 1948, pp. 31-33.

Tilton, **Noise Generators—Their Uses and Limitations**, **QST**, July, 1953, p. 10.

Receivership

Raymond De Vos W2TAM
140 Summit Avenue
West Trenton, New Jersey

HAVE you ever wondered what happened to *Hogarth?* He was the little fellow with the big eyes, the oversized glasses, steel helmet and fatigues who used to peer at us from the pages of various amateur magazines promising us a new and better receiver as soon as the war was over.

The war has gone, but I am beginning to suspect that Hogarth never made it. Poor fellow! While waiting for the promised receiver I bought some other post war samples, just to stay in the field. I knew exactly what I wanted. First of all it had to be stark. This means, no chrome trim or aluminum strips, no multicolored dials and various shades of grey finish . . . just plain black crackle finish with bare knobs. I assumed that the more functional it looked, the better should be the insides, and even if this were not the case, the casual onlooker would never suspect that it wasn't all it appeared to be. Then it had to have razor-sharp tuning with at least 10 cycle resetability, noise limiter, AVC, BFO and you name it.

Guess what I settled for? Tuning characteristics at least 10 kc wide, this in order not to miss anything (which it didn't), resetability fair with luck and a crystal calibrator (outboard type), no noise limiter, no S meter and a barely functioning BFO. The color scheme ranged from emerald green to dull beige, with a green on-off switch lamp and red and white dial lights, aluminum ventilating louvres, chromed skirting and gilded knobs. The dial mechanism was a wonder to behold. It looked like a spider web of string held taut by some half dozen springs all propelled by a counterweighted knob of gargantuan proportions. A flick of the dial knob would cause the pointer to travel from one end of the

slide rule dial to the other with incredible speed, and unless you were agile enough to stop the revolving knob before it reached the end of the dial scale, the pointer would disappear from sight and could only be retrieved from the innards by dextrous use of tweezers, forceps or haemostats. It was easy to hear the rare ones with this receiver because they were all rare.

After struggling with this unit a few months and wondering why there were so few amateurs on the air I finally succumbed and traded it in on another one. This one was sure to be better, at least it had an S-meter and less color. The dial mechanism was alledgedly gear driven, but sprocket driven would have been more exact. A quarter turn of the knob would move the dial fine, but somehow the tuning condenser failed to get the message. This receiver was advertised as a "surprise" and it sure met all qualifications. It was a surprise when one turned the band change switch to 20 meters and actually got the 20 meter band, it was a surprise to see that the S-meter was not pinned, that the BFO functioned when it was needed, that there was no smoke coming from the power transformer, and that you could actually hear someone returning your call. The biggest surprise, however, I reserved for the dealer who took it in as a trade on another venture.

You guessed it, I was going to make my own. I faithfully copied a parts list from the article describing the receiver to be built and left the list with the owner of the radio emporium. A few days later he called me to come and pick up my order and mumbled something about it being complete but with a few minor substitutions. I was too worried about paying for the parts to care much about a few "minor" substitutions so I let the matter ride. When it came to the actual assembling and building I began to realize what "minor" substitutions are. Nothing would fit the original plan. The variable condenser was too long, the power transformer too big, the dial mechanism different, etc. . . . I did the best I could by changing the layout and stressing the economy factor, thus saving face. If anyone asked me, I could always claim that it was "more economical" that way. I hope secretly that I will never have to say that again. The receiver, when finished, performed remarkably well on the broadcast band. I cannot say what it could do on the other bands since I never heard anything there. Eventually I dismantled the "thing" and put the parts in "stock" and set out to buy another one. This time I was going to get what I had always wanted, no matter what the cost, and I was not to be swayed by honeyed words from specialists in selling radio receivers. As luck would have it, by the time I had enough cash scraped together to make a downpayment I heard of an amateur on the other end of town who was

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moving, or going into the army or to college (a standard one) and was obliged to shed his equipment including a very very excellent low mileage receiver. I fell for it and he got my money and I got his "junk." I hope he went into the army and was sent to the North Pole. I know for certain that he had no choice but to move after he sold his equipment. Of course I had a "try before you buy" test, but I had no standard of comparison since my previous experience had been limited to practically dead silence. To me it sounded good, and evidently my friends had been bribed to say nothing since none advised me against this purchase.

After a few months of extensive dial twisting, band changing, tube changing, trimmer adjusting, *if* adjusting and broadcast listening I gave up and advertised it for sale very cheap. To date no one has come forth, and perhaps no one will. I hate to give the thing to a young amateur for fear of giving him the wrong impression of amateur radio. In all fairness I must say that the dial mechanism incorporated in this receiver was the MOST. It looked like a four speed synchromesh transmission and even had a clutch to match. I could scan the BC band in first, second, third or fourth and if I just wanted to turn the knob and change nothing I even could do that. Secretly I think it was the gear box that sold me and sometimes I am tempted to remove it and put it on the desk just for the amazement of visitors or as a conversation piece.

Since I absolutely had to have a receiver and cash was a bit hard to come by, I saved what I could and plunked it down for a surplus receiver. Even when I bought it I knew it would only be a stop-gap, a temporary measure, until I could save more and buy the best. Since I paid for it by the pound there was little justification in complaining. Sure, it had some drawbacks but they were only "minor" ones. The receiver tuned from 4 kc to 18 mc and picked up every signal between these frequencies. The forty meter band was covered in ⅛" of dial and the 20 meter band in ¼" space. It took a steady hand to separate stations, but I still had one then. The lack of bandspread was admittedly a little inconvenient, but a magnifying glass and holding the breath while tuning overcame this handicap to some extent. There was no S-meter, but I surely did not need one after all these years. In retrospect, I believe the feature that finally made me get rid of it (trade-in) was a rather peculiar phenomenon which went as follows. There were four bands with a band switch to select any one band. The receiver functioned very nicely about the center of each band, but at either end, when tuned for maximum gain, it would issue the most agonizing howl ever heard. I am strictly against cruelty to animals and this sounded too much like a shot rabbit. Even the XYL and the kids begged me to stop. Rather than having the family ostracize me and getting the SPCA to issue a summons or to make an investigation, I decided to part with the surplus gem. Honestly, it did not take much urging, and this time I had the family on my side so I went in hock, but good. I bought the latest and most super-duper job available to my limited means. There are no more shrieks from the receiver, but only moans from the operator when the monthly payments are due. So, how do I like it? Well . . . of course, I have an S-meter and lots of other goodies but I also have a rubber dial. The manufacturer of this unit must have a ball of pure latex between the dial and the tuning condenser. If I set the dial of 3620 kc and release the knob it promptly jumps back to 3610 kc. Perhaps the idea is to tune 10 kc. high and then let go. This may be an idea in the field of semi-automation, but since I can hardly keep up with new developments the understanding of this new tuning system escapes me. At any rate, it confuses my friends and leads to no end of merriment all of which does not help me to tune in any wanted stations.

In looking back I see that every receiver I ever owned had at least one redeeming feature. Now, why should I not be able to find one that had the best of all my previous ones and none of the bad features? Basically there is circuitry and tuning mechanism. I promise myself that the "next" one will have the best of each. Oh well, I guess I will have to buy another receiver. . . .

. . . W2TAM

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Letters

Dear OM:

I read your reply to W6RNC in December 73 Magazine and feel very strongly about your reaction. If you had ever read the Communist Manifesto, the book, Masters of Deceit or "The Naked Communist" you certainly should know that no Communist can be trusted. If these hams have talked with Americans it is not in good faith, but to learn something. You should know that they would never be allowed to operate unless they were fully indoctrinated in communism. I am actively engaged in educating the people as to the facts of communism.

John L. Satterlee K9LLT

It is obvious that you are not a DX'er and haven't yet worked a Russian station. I'd like to see you find one single U.S. amateur who does contact the USSR stations to back up your statements. Are these the kind of "facts of communism" you are engaged in educating? Yes, I've read Masters of Deceit. Since my interest in nudity hadn't progressed beyond the Danish sunbathing magazines I hadn't thought to read "The Naked Communist." Howsomever, the following letter may be interest. . . . Wayne.

Dear Wayne:

Do you suppose that "Super American" W6RNC failed to pay his dues in the John Birch Society, got a Section 8 from the California Vigilantes and now figures to make a name for himself by stirring up ham radio? I was dismayed to read his ad in CQ because he will undoubtedly attract some other do-gooders like himself, not even to mention some communists (non hams) who will seize any opportunity to forment dissent. It was a relief to read your reply to his letter. I hope enough hams read your letter to kill this deadly idea.

Despite the wrangling that sometimes goes on over the air on ham problems, we have a pretty democratic hobby. If you went to a ham club meeting and saw the gang whom you had known many years, could you guess how many were Democrats and how many were Republicans? . . . or Communists for that matter? K2JFV spent six weeks in Russia this summer and he tells me that their hams are the same way. The common interest is the hobby and they just don't talk politics. For a Russian to get to be a ham and to have equipment capable of working the U.S. means that he has to be a pretty smart fellow and have learned to speak our language. How many of these are there? How many would listen to a U.S. ham give him a line of propaganda? We are certainly much better off to let him listen to a happy bunch of W-hams enjoying their hobby and leave him just a bit envious.

Edson Snow W2BZN

Dear Wayne:

Re your 73 Reviews the QZ-535 Receiver on page 66 of the December issue; I have used this receiver in conjunction with my HQ-110 for about six months and find it will do all W4UWA says it will. On the 20 and 40 meter bands you can cut the selectivity down to one or two kc by throwing in the Q-multiplier. These receivers are made by the handicapped persons of the Sheltered Workshops, Inc., Santa Monica, California. When you buy one of these receivers you get a nice little certificate.

Al, W4LSA

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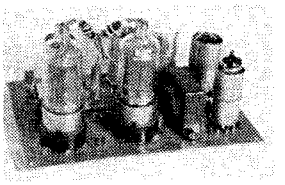
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Values, etc.

Jim Kyle K5JKX

MANY things prove puzzling to the newcomer to ham radio construction: what kind of tube sockets should he use, how should he arrange the parts on the chassis, what tube can he substitute for that XYZ-34ABX his dealer never heard of?

For lo these many months we at 73 have been trying to help him find the answers, as well as to help his more advanced brethren find new projects and ideas for construction. Most of the newcomer's questions can be answered speedily.

But one question which comes up frequently may leave even an old-timer at a loss for a good answer: "Why don't they make, say 41,300-ohm resistors? Why do resistors come only in these odd-ball values like 33, 39, 47, or 56 ohms?"

It's a good question, too. Often, when we calculate the size of the resistor we need for some circuit where both voltage and current are critical, we come up with non-standard values. It's only natural to wonder why we can't go out and buy the size resistor we need.

There was a time—nearly 20 years ago now—when you could do just that, almost. Before World War II, resistors and capacitors were marked according to a decimal standard system. The values went something like this: 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100. Then the series started all over again 150, 200, 250, etc. Then, if you needed a 50,000-ohm resistor, you got one of that size—not one marked 47,000 ohms instead.

That is, you got it if your supplier had it in stock. With 18 different values of resistor to stock in each 10-to-1 resistance range, he had to keep 90 different sizes of resistors in stock to cover the range from 10 ohms to 1 megohm; on top of this, he had to stock each of these 90 sizes in ½-watt, 1-watt, and 2-watt units, and each of the 270 resulting kinds of resistor in 5-percent, 10-percent, and 20-percent tolerances. With 810 different resistor bins on the shelf, it's small wonder one or more of them was often empty!

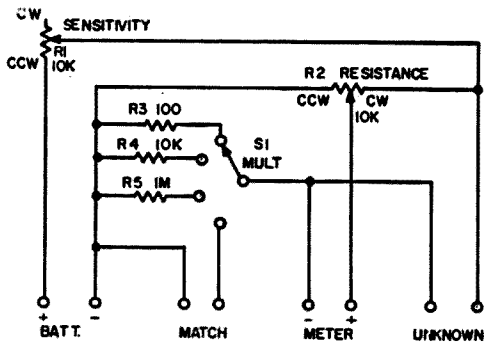


FIG. 1

With the need for rapid increase of electronics manufacturing capability in World War II, 810 different kinds of resistors (not to mention the additional 810 units introduced by the need for both wire-wound and composition types) proved too much of a good thing for the armed forces.

About that time, somebody figured out that it was totally senseless to make resistors in such value steps as "75, 80, 85" if the tolerance was no closer than 20 percent. The reason is simple: a resistor marked 80 ohms, with 20 percent tolerance, may have an actual value anywhere between 64 ohms and 96 ohms. In such a case, why even bother to have values of 65, 70, 75, 85, 90, or 95 in the series—you couldn't tell the difference!

This two-pronged idea—to reduce the number of different types in stock, and to make the resistance steps more realistic—produced the set of odd-ball values we can buy today. The steps, for 20 percent tolerance, run: 10, 15, 22, 33, 47, 68, and then repeat for the next decade. Thus, a 10-ohm resistor with 20 percent tolerance may be as large as 12 ohms. A 15-ohm unit, also 20-percent tolerance but on the low side, may be as low as 12 ohms. In this manner, the possible resistance values meet and the total 10-to-1 range is covered.

You can see how the number of values is cut down, too. The old system had 18 different values between 10 and 100; the new one has 6, for 20 percent units.

If you need closer tolerances, of course, you purchase 10-percent rated units. These, naturally, won't cover the entire range with only 6 values; the number of units moves up to 12. The steps, for 10-percent units, run: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82. You can see that these include the original six values, plus the six "halfway-between" values which mark the tolerance limits of each of the original six values.

For 5-percent tolerances, the "halfway-between" points of the 10-percent scale must be added as well; this results in 24 steps. While this is six more steps than were used in the older scale, the old scale didn't cover the entire range (there were holes between values). The 5-percent tolerance scale is: 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

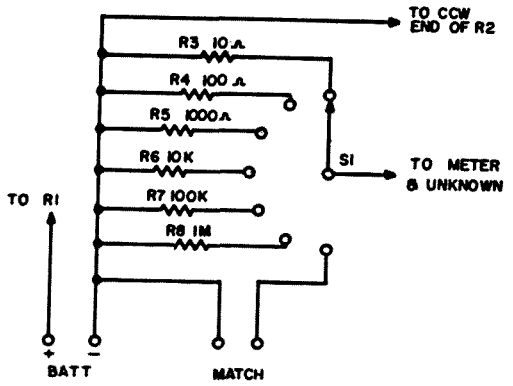


FIG. 2

Fig. 2. For added accuracy, add three more steps to the MULTIPLIER switch as shown here. Parts not shown or listed are the same as in Fig. 1. The MATCH terminals are used when matching two resistors to be the same value, when the closeness of the match is more important than the absolute resistance value. This position is handy in alignment of phase-shift filters, and in audio work.

Thus, with the old scale of 18 units per decade, 54 values were needed in each decade to include all three tolerances; with the new scale, only 42 values are needed. The dealer need stock only 630 types of resistor, instead of 810 as before.

When the new sets of values were first introduced, they were applied to resistors only. However, they are also applicable to the marking of capacitors—with the same advantages—and so the industry began switching over its capacitor markings to this scale also. This switchover is still in progress; for instance, most firms make 0.005 mf disc ceramic capacitors, but it's hard to find that value in a paper tubular unit (but easy to get a 0.0047 mf one).

This answers the question, "Why the oddball values?" Yet to be answered is the implied question, "How do I get a 41,300-ohm resistor if I need it?"

The obvious answer, of course, is to connect a number of resistors in series to get the desired value: say, a 33K, a 6.8K, and a 1500-ohm resistor. These values total 41,300 ohms exactly.

But this answer isn't always right. The "33K" unit could actually be anywhere between 27,000 and 39,000 ohms if you use 20-percent-tolerance resistors. Likewise, the 6.8K could be anything from 5600 to 8200 ohms, and the 1500-ohm unit could be between 1200 and 1800 ohms. Thus, your "41,300 ohms" would come out to be somewhere between 34,100 ohms and 49,000 ohms.

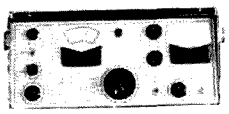
If this range of possible values is satisfactory to you, there's no need to use three units; two resistors (33K and 10K) in series total 43,000 ohms nominal value, with about the same spread of possible values. And by going to a 10-percent unit, you could buy either a 39K or a 47K resistor; either of these falls within the range of the composite unit's tolerance.

The closest single resistor available of those we've listed so far would be a 43K, 5-percent unit. This is only 1700 ohms (about 4 percent) away from the desired actual value, and the 5-percent tolerance guarantees that actual resistance is between 40,850 ohms and 45,150 ohms. Cost of a 1-watt, 5-percent resistor is 35 cents.

If, though, you must have 41,300 ohms plus or minus as little as possible, you have one of three courses open to you: you can select from a number of 43K, 5-percent units, using an accurate (1-percent tolerance) resistance bridge, until you find one that is the exact value you need; you can use a variable resistor of about 50K ohms (or a 33K fixed resistor in series with a 10K variable, for "bandspread") and again adjust it to exact value with the aid of an accurate bridge; or, finally, you can build up the value you need from 1-

(Turn Page)

Swan SSB Transceiver

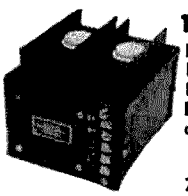


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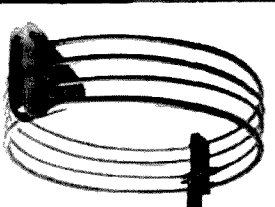
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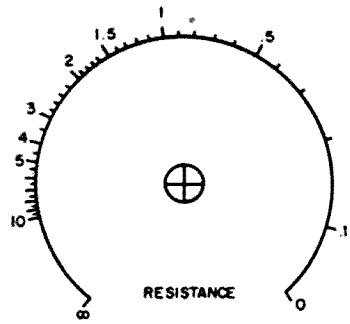


FIG. 3

percent tolerance resistors. A 41.2K unit in series with a 100-ohm unit would give you 41,300 ohms exactly (nominal value), with tolerance limits of 40,882 and 41,718 ohms.

Since the standard values for 1-percent units include 96 steps per decade, it's a bit large to include here. It's printed in full on page 112 of Lafayette Radio's 1961 catalog, however, together with the prices of 1-percent units: 1-watt, 1-percent resistor prices *start* at 90 cents each, so be sure you need that kind of accuracy before investing in precision resistors.

Earlier, we menitoned an *accurate* bridge as a help in selecting exact resistance values from a number of similar units. As in everything else, accuracy isn't cheap. While the $20 variety of R-C bridge available from almost every kitmaker is a great help around the experimenter's bench, "four-digit" accuracy is not among its strong points. To get accuracy to four significant figures in a bridge costs considerable amounts of cash; as a ham, such an investment would be much better spent in, say, a Tektronix 545 scope (around $1000) and the surplus left over after buying the scope could put you up a set of 80, 40, 20, 15, and 10-meter stacked 3-element beams!

We may have exaggerated the cost of a four-digit bridge a bit in that last paragraph—but not very much if any. The point is, you'll never have enough use for one to justify the investment. On the rare occasions that you *do* need such a gadget, contact the physics department of your nearest college or university; most of them have such instruments, or can at least tell you where one is located.

For general use, though, in *matching* resistors against each other to 1-percent accuracy or in measuring individual resistors to within about 2 percent, an inexpensive bridge is a handy thing to have. As mentioned earlier, you can buy one in kit form from Heath, Eico, Paco, or almost any other manufacturer of test instrument kits.

However, if you already have a VOM in the shack (you mean you don't! Get one!) you can put one of these bridges together for considerably less than $5. The schematic is shown in Fig. 1; as shown, you can measure resistance between 10 ohms and 10 megohms, but accuracy falls off somewhat at each end of each

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of the three ranges. You can get better accuracy (at slightly higher cost) by adding three overlapping ranges as shown in Fig. 2.

Construction is simplicity itself—the only essential thing is to make sure the indicator dial can be read to the accuracy you want. A sample dial face suitable for the specified potentiometer *only* is shown in Fig. 3; if this dial face is enlarged to 5 inches in diameter, you can easily read values to 2-percent accuracy. Enlarging the dial face to 10 inches would allow 1-percent accuracy of reading, but the components specified won't give you more than 2 percent accuracy anyway so making the dial face larger than 5 inches is a waste of time.

In case you may be wondering about the calibration of the scale (especially if you're hep about Wheatstone bridges), this scale compensates for a slight irregularity in the potentiometer as well as reading out the multiplier for the resistance.

To use this bridge, connect a dry battery (at least 3 volts) to the BATT terminals, connect the VOM to the METER terminals, set the MULTIPLIER switch to the approximate value of the resistance to be measured, and set the SENSITIVITY knob to its full-clockwise position. Now, set the VOM to the lowest current scale which does not pin the needle. Set the RESISTANCE knob to the extreme clockwise position (below 0.1), and adjust the SENSITIVITY knob for a full-scale reading on the meter.

Now, connect the unknown resistance to the UNKNOWN terminals and adjust the RESISTANCE knob for a dip on the meter. When you achieve the dip, readjust the SENSITIVITY knob for full-scale reading again and attempt to deepen the dip. When the bridge is properly balanced, the meter will indicate zero current on its most sensitive scale, with the SENSITIVITY knob in its full counter-clockwise position. At this point, the product of the readings on the RESISTANCE and the MULTIPLIER scales will be equal to the resistance of the unknown resistor; for instance, if the MULTIPLIER is set to 10K and the RESISTANCE scale reads 0.92 at balance, the unknown resistor is a 9,200-ohm unit. Since accuracy of the bridge is 2 percent, it would be more precise to say the value of the unknown resistor is between 9,016 and 9,384 ohms.

One caution is in order—when you're working near the balance point, most of the protective resistance (inserted by the SENSITIVITY control) is out of the circuit; thus, if you should joggle the RESISTANCE knob far off the rated value, you might send enough current through the meter to damage the movement. There's no danger to the meter if you're careful—but always return the SENSITIVITY control to its extreme clockwise position before either moving the RESISTANCE knob or disconnecting the unknown resistor.

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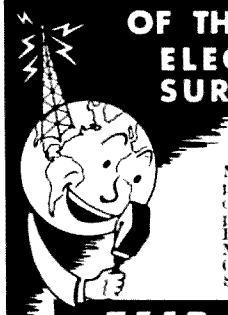
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(W2NSD from page 4)

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803	2.95	6SN7	.40	5CP1	4.50	1698	25.00	Antenna Dish—Parabol reflector, 30 inch	4.95
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the seal in gold while QST managed a beige color and CQ used the usual red.

Dear FCC

I see you are now officially proposing a license fee for us. In my usual role as champion of unpopular causes must cheer you on. I sort of wish that your proposal had mentioned even briefly that we would get something extra for our money. It is difficult to have to start paying for something that you are used to getting for free . . I will refrain from giving any examples as proof of this statement. It would be nice if you could give us little extras such as regular FCC examinations for the Technician license instead of the present "honor" system. We'd like to have a chance to get special call letters where there are extenuating circumstances, as we used to. We'd like to have more leeway for experimentation with special licenses for repeater stations and other new projects that don't quite fit in our present system of rules. We are not interested in just having the radio tax join all the other tax monies in the big pot in Washington.

If my experience in twisting arms for magazine subscriptions at hamfests and conventions for over seven years is any indication you may find the amateur ranks thinning faster than they are growing at present. Five dollars seems like a modest sum when you compare it with the money that fellows will spend for cigarettes, drinking, movies, and Collins gear. Join me at the next convention and hear about 2000 hams stop by the booth and explain that they sure want to spend the $5 to subscribe, but they just don't have that much saved up yet. Some bring along their wives and try pitifully to coax them out of this enormous sum.

Now, though I'm basically opposed to the doctrine of "Something for Nothing" and prefer to pay my own way whenever I can rather than taking a free ride, I must admit that the proponents of free ham licenses have a good point. We hams do provide a rather fine pool of technical talent for tapping in time of emergency, as we proved during the last big fray. We also provide a pool of otherwise non-subsidized experimenters whose output dwarfs even the largest commercial or military laboratories. In case you're suffering from shortness of memory I might remind you that the parametric amplifier was first operated on six meters We more than pay our way every time there is a local emergency anywhere in the country. Ham radio is the most flexible and ubiquitous emergency communications system there is. For every real public service performed by a commercial-broadcast or TV station we can point to 50 amateurs who have done more.

(Turn to page 92)

READ AND SAVE

Axial Blower 24 vdc 58 CFM (wks on 12)....	$2.95
WE 255A Polar Relay	4.50
Sockets for WE 255A Polar Relay (new).....	2.50
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or 2 for $5.00

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AN INTERESTING ARTICLE ON ABOVE KEYER April '73; page 66.

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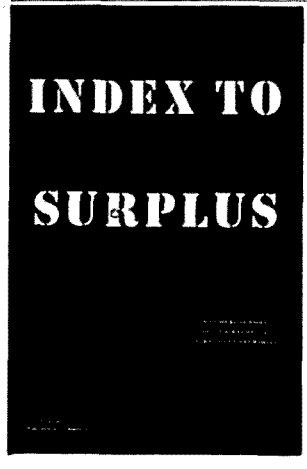
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To sum up: if your purpose in proposing the $5 license fee for amateurs is to provide us with better service and you are not concerned with the drop in our numbers that will probably result, then tax away. We are already taxed, double taxed and triple taxed on just about everything we buy or do, many of us probably won't really notice this extra dun.

June Last Year

Advertising was up a little in June, so we increased from 64 pages to 72. The supply of June issues is running short, so if you want one don't put it off for long. Still only 50c.
One of the best articles was by John Reinartz K6BJ on precision capacity measuring. His simple method is one you'll find very useful if you do much construction and experimentation. You can get it right down to the fraction of a mmfd. Bill Orr W6SAI came up with some good ideas on improving the Lafayette KT-200 receiver. The ideas also apply to most other lower priced receivers. K2TKN introduced his Abe Lincoln two meter antenna. This has a lot of advantages over the halo for both mobile and home use, the only problem seems to be one of construction . . . and unusual looks. WA6DZL ran a short article on a little transistorized 75M converter. W4API tested the Electrotone M-100 modulator. K2IGY's part II of his two articles on the sunspot minimum which we are approaching . . . discouraging. W5SUC came up with an elaborate AM modulation monitor. W6AOI presented part I of his two part article on a simple padapting adaptor which connects your receiver to your oscilloscope so you can see the bands while you tune. Then we had a transistor gadget for preventing overmodulation, clever idea. The big staff article started to tackle power supplies and found it too much for one article. K5JKX showed us how to use punched cards for keeping track of magazine articles. W6NKE imparted some ideas on DX chasing which should be reread by everyone. There were a lot more short articles filling in the cracks between the big construction and technical articles. Better send for a June '61 now. 50c.



Roy Pafenberg W4WKM has accomplished a major effort in this compilation. It lists every known surplus conversion article, giving a capsule rundown on the conversion accomplished and the magazine in which it was published. If you do any surplus conversion work this book can save you a lot of time by telling you exactly what conversions have already been published. 64 pages packed with information. **Price ...$1.50**

73 Magazine
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On the lab bench and in the field . . .

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FROM QST — JANUARY 1961

"Stability, both mechanical and electrical, is exceptional . . . The NC-270 works well enough on 50 Mc. to encourage a v.h.f. enthusiast to design his converters . . . so that they will work into the 6-meter range rather than into the lower bands. This would give him full coverage of the 144-Mc. band and a four-megacycle spread in any of the bands from 220 Mc. up . . . and he can skip the construction of a 50-Mc. job. The NC-270 should do all he'll need in that range."

FROM CQ — MAY 1961

" . . . retains all the "feel" of the more expensive receivers for which this company is known . . . It is unusual to see a front panel NOTCH DEPTH control in this price class . . . The a.n.l. circuit in the NC-270 is exceptionally good . . . Mechanical stability is impressive. It is possible to tune a s.s.b. signal on one of the high frequency bands, lift the front of the receiver up several inches and let go. Unless the main tuning knob moves, the signal will still be there . . . (The National NC-270) is an extremely stable and sensitive receiver . . . "



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If you want a proven medium priced receiver, we strongly suggest that you hear the NC-270 at your dealer's. Write today for technical information.



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AMATEUR RADIO

73

July 1962
a paltry 40¢



420 mc by W4HHK

VHF Construction

All Band Nuvistor Pre-selector

73 Magazine Peterborough, New Hampshire
Wayne Greene W2NSD—Editor, etcetera

July 1962 • Vol. VIII, No. 1
Phone: DE 6-8880

The 420 mc Band ..... Paul Wilson W4HHK 6
Inside dope on this interesting band by a real expert.

Six Meter Nuvistor Converter ..... John Sury K8NIC/5 12
Designed to plug in Drake receiver, but will work with anything.

VHF Construction ..... Larry Levy WA2INM 14
Heed well this article and you may save yourself a lot of misery.

The Eico 720 on Six Meters ..... James Beckett WA2KTJ 18
You just add a separate pi-net coupler and there you are.

Finding True North ..... Andy Wisler KH6BW 20
Handy if you are lost in the woods.

Modifying the HE-35 ..... Larry Levy WA2INM 22
Revisited.

All Band Nuvistor Preselector ..... Fred Cupp K8AOE 22
This little gadget makes quite a difference.

Transistorize that Meter ..... Carl Henry 26
Making VTVM's out of those VOM's.

Rambunctious Radiations ..... James Ligon W4KOC 30
It's the location that counts, not the antenna.

The Windom ..... Drayton Cooper W4WXY 34
Resurrected and placed carefully on a pedestal.

The Whistler ..... Bill Leonard W2SKE 38
Or how to use an island as an antenna.

Power Booster ..... Jim Kyle K5JKX 42
Replace that 6146 with a 6DQ5 and watch the signal increase.

The Engineer and the Transistor Radio ..... Bobby Rodgers 46
Humor.

Vermin Traps and Dragon Eggs ..... Sidney Rexford W2TBZ 50
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Selectivity Plus ..... Don Wherry W6EUM 58
105 cycle selectivity with a simple audio filter.

Propagation Charts ..... Dave Brown K2IGY 62
What time to where, in all probability.

An Old Friend In A New Suit ..... Bob Baird W7CSD 64
The ARC-5 rides again.

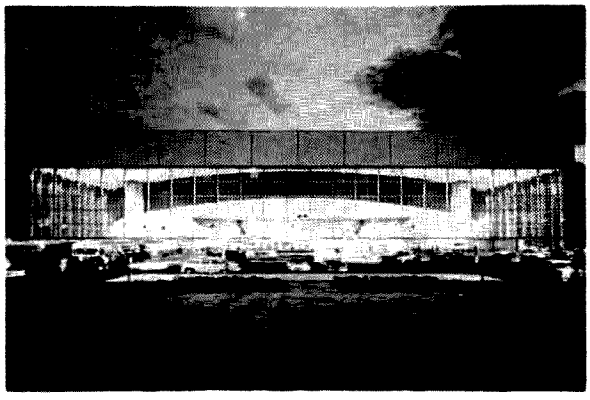
Dear Friend ..... Douglas Hedin KØOFB 66
Keeping those Indians on the reservation.

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. . . de W2NSD

. . . never say die



Convention Hall

National Convention

The gang up Oregon way are cooking up quite a convention. Though it has been my policy to let the League promote League functions, there is an off chance that some eyes might scan this page that might otherwise miss the news through a too-hurried scanning of QST's pages. The convention will be held at the Portland Memorial Coliseum on September 1-2-3. There will be exhibits, talks, prizes, tours, and all other convention-like events. Drop a note or QSL to Convention, Box 1335, Portland 1, Oregon for a nice brochure. Perhaps by next year I'll have 73 well enough in hand to be able to get to some conventions. I sure wish I could make it to Portland and the nearby Seattle World's Fair for this National ARRL gathering.

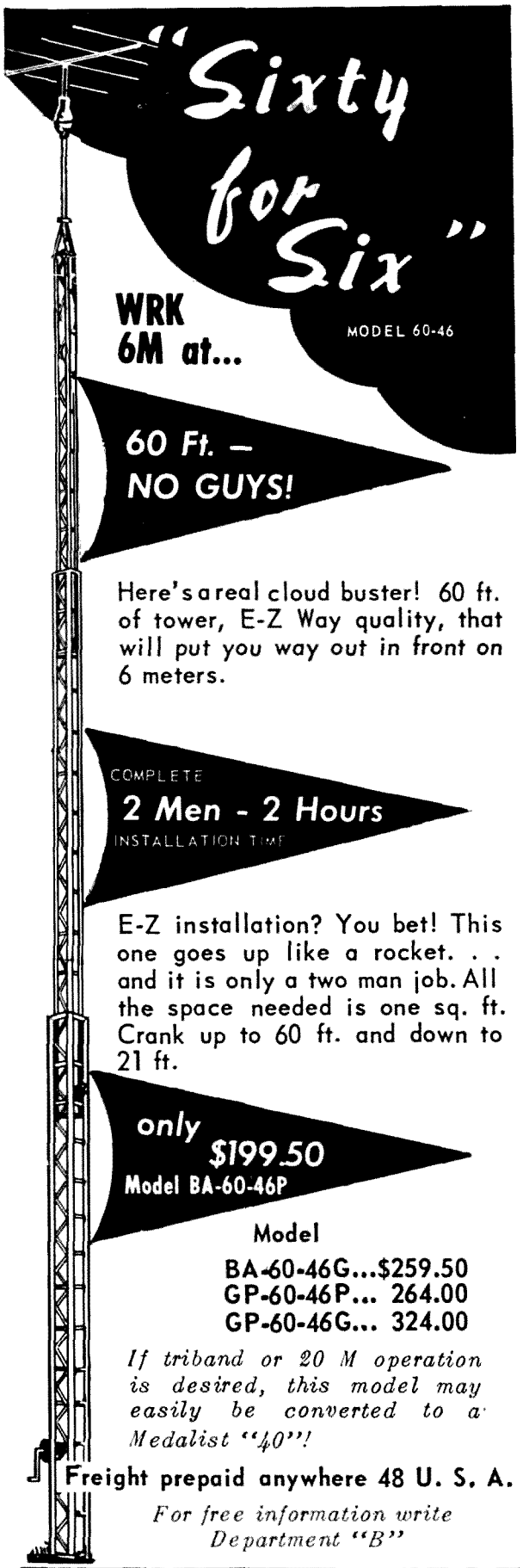
. . . de W2NSD/1

If you are normal and read the magazine from the back, you have probably already noticed that I have cut down the number of pages in this issue even though there are plenty of ads. There is a method in my madness. It isn't just that I think you have been living too high with us publishing 27 feature articles last month to seven and eight in the other two ham magazines, it is only that I have to save a little money this month so we can move our editorial offices to a new location. Let me explain.

In the interests of economy we have been publishing 73 from a small, dingy apartment in Brooklyn. This has been incredibly frustrating for we have been cramped and have not been able to set up anything passable in the way of a ham station. Thus, for well over a year we have been trying to figure out where we would most like to have the magazine located. We looked over Westchester County pretty carefully and found that in most places ground was sold by the foot, not the acre. This makes an antenna farm awfully expensive. Next we investigated upper New York State, then Connecticut. Still too costly. We finally decided to look for our new home in lower New Hampshire. This seemed to offer us the most. It would only be an hour or so out of Boston so we could get all the big city services we need for running a publishing business. It would be much cooler than New York and more comfortable for working. Land is so much lower there that we could afford something a lot nicer than we could manage further south. New Hampshire has extremely low taxes, the third lowest of all the states! Thus, should we ever make any money, we would not have to immediately turn it over in taxes.

On May 30th Virginia and I settled into the Porsche and headed for New Hampshire to find our new headquarters. After trying two different real estate salesmen we came across a natural: John Peterson in Peterborough. John had a Porsche Speedster just like mine. It didn't take long until we were on our way to our new offices.

We had discovered that it is difficult to buy a large house and grounds if you don't have any money. This developed into quite a stumbling block. It didn't even slow John down, he immediately thought of a place that was available for rent. We drove over, looked at it, and knew immediately that this was for us. Wait'll you see it! There are so many rooms that even I will be hard put to fill them up. We counted at least 20 rooms and five or six bathrooms. There is a huge garage that will hold all of the cars that happen to be visiting. There is even a nice modern clean barn. We walked from



room to room mentally planning where the ham shack would be, the test lab, the workshop, the subscription department, the art department, my office, the library, and so on. We thought John was kidding when he said there was a bowling alley in the attic . . . there it was! The rent? Almost exactly what we have been paying in Brooklyn!

When we get all set up in Peterborough the welcome carpet will be out for all passing hams. Just look for the tri-bander on route 101 as you come into town from the east.

U. S. Gum Mint

Most publishers probably have been reading the news stories about the proposed raise in postage rates with the same horror that I have. They are apparently about to increase first class mail, airmail and second class rates. This will, as you have no doubt read, have a profound effect on your magazines. We can probably survive, but it will mean an increase in the subscription rate.

There are two basic problems at the root of this increase. Not only do we have a constant devaluing of the dollar, but our post office is getting more and more out of date and has been trying to meet the growing flood of mail with a growing mountain of employees. If we were using hand set type and hand presses our costs would be a lot higher. We do not meet growing demand for magazines by hiring more men to hand set type; we use machines. The sooner the post office recognizes the fact that they are going to have to automate and seriously sets about doing it, the sooner they will be able to give us the service that we should be able to get in this day of jet planes and television.

"Now Mr. Green, as the new Postmaster General, what do you propose to do about the department?"

"I'm glad you asked that question. As the new Postmaster General I propose to make sweeping changes."

"That's fine, Mr. Green, but can you give us an idea of what some of these changes might be? Can you be a little more specific?"

"Yes. We're going to meet the challenge of the modern world with modern methods. We're going to *automate*."

"But Mr. Green, Postmaster Summerfield tried that and wasn't it found to be impossible? Didn't the automated post office in Providence fail rather miserably?"

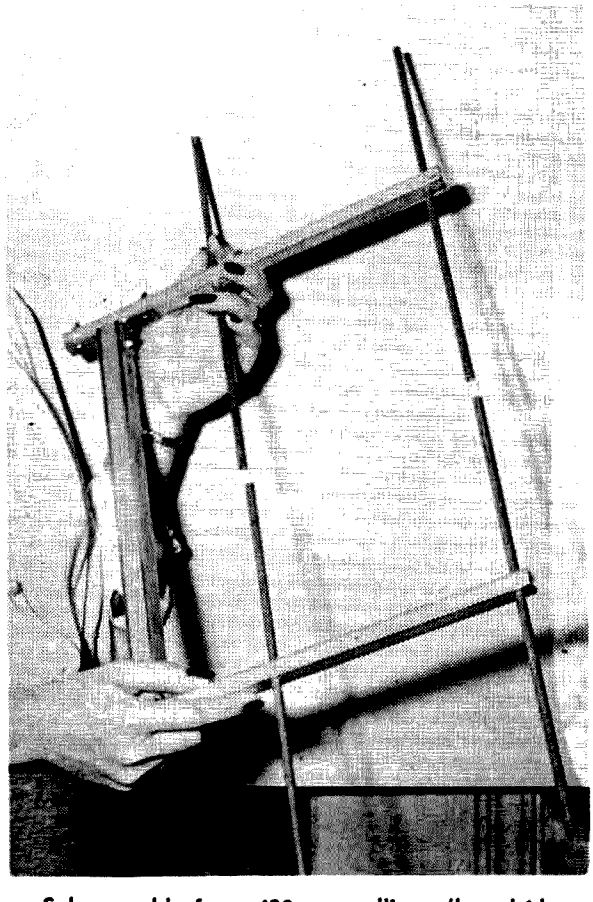
"Hmmm, yes, a few snags did crop up

(Turn to page 69)

The 420 mc Band

Paul M. Wilson A/W4HHK
226 Peterson Lake Road
Collierville, Tennessee

THE 420 mc band is located near the low frequency end of the UHF portion of the radio spectrum, and is equal in size to all of the radio spectrum lying between the lowest radio frequency used and the high end of the ten meter band. Think about that for a moment . . . all of the amateurs operating on all the amateur bands from 160 through 10 meters could operate on the 420 mc band, and with much less QRM. Of course the range of a typical station is limited . . . from across town out to a hundred miles, depending on terrain, but it can be used to good advantage for local work and for experimenting. At this frequency the size of a dipole is so small, approximately 12¾ inches, that an array producing worthwhile gain may be constructed in the attic workshop and even used there for short haul experimenting and contacts.



Sub-assembly for a 432 mc. collinear/broadside all-metal (aluminum) array. Elements are one quarter inch diameter aluminum tubing. Booms and horizontal support are one half inch square aluminum tubing. Spacing between driven elements and reflector elements is one quarter wavelength, permitting use of driven and reflector elements having identical length.

Propagation is primarily tropospheric. At this frequency ionospheric propagation does not occur and reflections from meteor trails or the aurora borealis are almost nil. The fifty watt input power limit does not help matters, but it is hoped that some day this can be raised. The various types of emission permitted on this band allow the operator a wide range of choice. They are Aϕ, A1, A2, A3, A4, A5, and FM. Yes, amateur television, A5 emission, is permitted on the 420 band. Usually the audio portion of the transmission is made on another VHF band such as the six meter band. In listening to other amateurs discuss this band you will often hear them refer to operation on 432. The band actually extends from 420 to 450 mc, but because it is convenient to triple from the low end of the 144 mc band, thus producing a frequency of 432 mc, it is common practice for those using crystal controlled equipment to operate in the range 432-435 mc, hence the reference to "432" instead of "420."

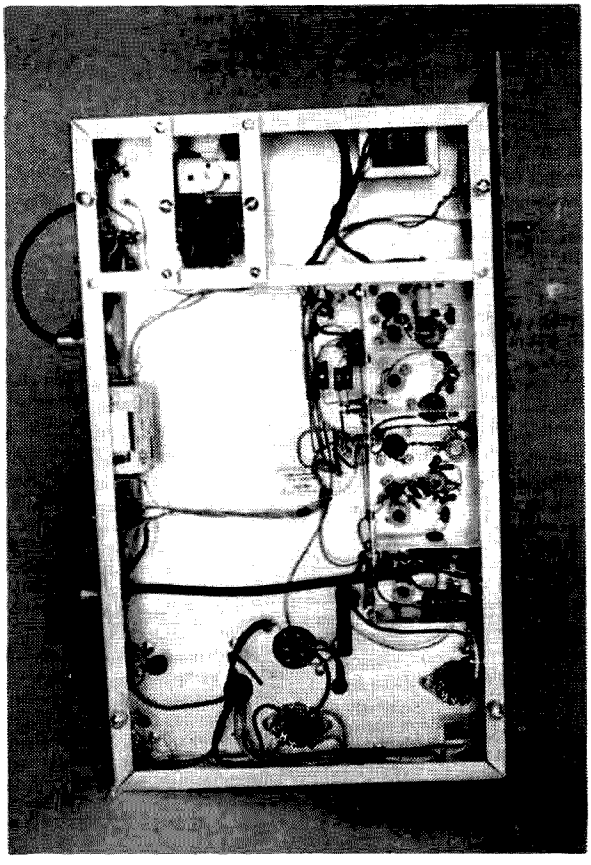
Some operators get their start on this band by using modified surplus equipment of the modulated oscillator variety, or by building it themselves. The band is wide enough to accommodate these unstable signals without much danger of off frequency operation. Receivers used for such signals are wide band type and no very sensitive as UHF receivers go . . . but the simple equipment does allow one an easy means of diving into the fun of operating on 420. As experience is acquired the operator soon learns that better results are to be obtained by using stable crystal controlled transmitters and low noise, crystal controlled converters. In some ways, the use of this type of equipment is easier to handle than the simple oscillator type. For example, output frequency of the transmitter is a definite multiple of the crystal frequency. With the modulated oscillator the frequency obtained is anybody's guess and not easy to measure. Finding a wandering signal in a band that is thirty megacycles wide is a difficult job. Earlier the matter of stable operation between 432 and 435 mc was pointed out. In actual practice the majority of the activity may take place between 432 and 433 mc. A check with local amateurs operating on this band would give you the information regarding this and the

matter of antenna polarization. It is important that your antenna polarization be the same as that of the other stations, for cross polarization means high signal loss.

Speaking of losses, one should bear in mind the matter of feedline loss. At this frequency it can be terrific, resulting in very little of the precious rf developed in the transmitter ever reaching the antenna. As an example, RG-58 coax has a loss of about 10 db per hundred feet at 420 mc. Expressed another way, this means that for ten watts fed into one hundred feet of RG-58 only one watt will reach the other end. RG-8 cable is somewhat better, having a loss of about 5 db per hundred feet. Amphenol 214-022 300 ohm line has a rated loss of about 2 db per hundred feet. It is easy to see that choice of feedline and keeping line length to a minimum are very important. One way to offset feedline loss is by use of a directional array. A sixteen element collinear/broadside array . . . a mere two feet wide by three feet high and less than a foot deep gives about 13 db gain over a dipole. A single long yagi with thirteen elements has a theoretical gain of about 16 db, but a word of caution is in order here. At this frequency the dimensions of a yagi are extremely critical. Elements that are not precisely the correct length and diameter will not produce the theoretical gain. There are some experienced operators who are not sold on the use of the yagi at 420 mc. The collinear/broadside type of array is a broad band type of antenna . . . dimensions not critical a bit . . . and can be built and erected without tedious tuning and adjusting, and be expected to deliver the advertised gain. Many will disagree on which type is superior . . . but you can find out for yourself . . . it is so easy to construct an antenna for 420 mc. It is worth mentioning that both types, a yagi and a collinear, were used on the 600 mile contact between W5RCI, Marks, Mississippi, and W8TYY, Columbus, Ohio. Other types of antennas are also employed on 432. The corner reflector is practical at this frequency. The reflector screens forming a ninety or sixty degree angle may be solid or of fine wire mesh, and have a width of one or two wavelengths and length of two to four wavelengths. The gain of a ninety degree corner reflector is on the order of 10 db and for the sixty degree corner about 12 db. Flat screen reflectors may be used to back up a curtain of driven elements. Some operators use such a reflector with elements on one side for 420 and elements on the other for 220 mc. Indeed, the 420 mc band is a fine place for experimenting with antennas. To give you a better idea of the materials needed and dimensions for a 432 mc antenna, the measurements for a typical sixteen element collinear/broadside array will be related. The design frequency is 435 mc, the center of the band. The driven element will be 12¾ inches long, the reflector element 13⅜ inches, and quarter wave spacing between the two amounts to 6¾ inches. The feed point impedance of a typical 16 element collinear/broadside array is approximately 300 ohms. If necessary, a quarter wave matching transformer could be used between the feedline and the array. Element diameter may be one eighth inch or larger. On quarter inch tubing is frequently used. In the construction of yagis the element diameter and length are both critical . . . the diameter being about one eighth inch. To sum up the antenna department . . . the antenna should be as large as possible and as high as possible, consistent with reasonable feedline length. A good quality, low loss line should be used.

Crystal controlled transmitters are not so difficult to construct as it might seem at first glance. For the operator already in business on the two meter band, a tripler-amplifier may be used to develop usable power on 432 mc. The station operating on the 220 mc band can multiply to 432 by retuning the 220 rig to drive a suitable doubler stage at 216 mc. All things being equal, a doubler stage can be expected to have greater efficiency than a tripler. Remember, the power limitation is power input . . . not output. Every effort must be made to achieve maximum efficiency in the transmitter and antenna system. Needless to say, a straight through amplifier would have the greatest efficiency. Stability problems might arise with this type of operation, however, so an efficient doubler stage should be considered. Tubes for this band that are within the reach of the average amateur are few in number. Many have started with nothing more than an 832A tripler that produced about two watts output. Such a final will produce contacts over many miles *if* a good antenna system is used. Other twin tetrodes that may be used as push-pull triplers and straight through amplifiers are the 6360, 6524, AX-9903, and 5894. Two very popular tubes for running the maximum input power are the 4X150 tetrode and 2C39 triode. Some use the 4X250 tetrode which has a greater dissipation rating. These tubes are built for use in a coaxial type cavity. Strip-line construction may be used, however. They may be operated as doublers, triplers, or straight through amplifiers.

The tube line up in a typical 50 watt crystal controlled transmitter might be as follows: a 5763 crystal oscillator using an 8 mc crystal, 5763 tripler to 24 mc, 5763 doubler to 48 mc, 6360 tripler to 144 mc, 832A amplifier at 144 mc, and 2C39 or 4X150 tripler to 432 mc. The order of frequency multiplication mentioned is quite common with many amateurs operating on the 144 mc band who use their existing two meter transmitters to drive a tripler for output on 432 mc. The other system frequently used is that making use of a 220 mc transmitter. The proper crystal frequency, approximately 8 mc, is used in place of that used for output in the 220 mc band, and the multiplier stages are retuned slightly for output at 216



Bottom-side view of 432 mc. converter at A/W4HHK. The compartments for the 50 mc. cascode i.f., second mixer, and cathode follower output stage are seen along the panel side of the chassis. Blower for the 416B r.f. stage is in the upper right hand corner and bias battery along the rear (top-center) of the chassis.

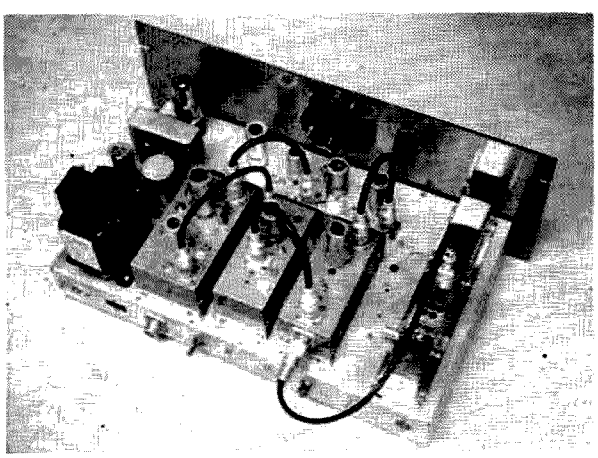
mc. A doubler is driven by this, providing better efficiency than can be obtained with a tripler stage. Stations employing a doubler stage in the output should be alert to the possibility of TVI to nearby TV receivers if channel thirteen is used in their area. The most common types of emission used are A1 and A3, with some FM. If long haul dx is one of the aims of the 432 mc operator a means of keying the transmitter for CW work is a must. A convenient way of doing this with a tetrode final is to use a keying relay to break the screen voltage.

Most surplus equipment obtained for use on the 420 mc band employs receivers that are without rf amplification ahead of the first mixer and with broad tuning *if* strips. These work well with modulated oscillator type transmitters, but are useful only for work over relatively short distances. The receiver noise figure is quite high, making them useless for weak signal work. To obtain maximum performance on the 420 mc band, a crystal controlled converter working into a stable high frequency receiver should be used. Only a few tubes will work satisfactorily as rf amplifiers at this frequency. The 416B, an expensive little bottle, or the 6299, equally rare, are probably the best generally available. The 6AJ4 is sometimes used. A good parametric amplifier is far superior to the best tube amplifier, producing a noise figure on the order of one db. Some UHF workers have found that a converter employing a 1N21F diode mixer stage followed by a low noise *if* strip will give a noise figure only slightly inferior to that obtained when a 416B rf stage is added ahead of this same converter. Parametric amplifiers are tricky devices to handle, and a bit more involved than a grounded grid 416B rf stage, but it is the opinion of some that the converter should use a 1N21F mixer/low noise *if* combination and if rf amplification (and lower noise figure) is desired a parametric amplifier should be added. In short, there is little to be gained by adding anything other than a parametric amplifier for rf amplification.

In the matter of first *if* frequency several factors should be considered. The rule of thumb method is that the *if* should be five to ten percent of the signal frequency. The *if* should not be so high, however, that it will be difficult to obtain a low noise figure, but should be sufficient to reduce image response to a negligible amount. Where a diode mixer front end is employed the noise figure and gain of the first *if* are very important. If the communications receiver to be used with the converter is a double conversion type and has good stability at the high end of its range the converter output might be 26-30 mc. If this range is not suitable on the HF receiver a lower one could be used and double conversion achieved in the converter. In such a converter the first *if* could be 50-54 mc and a second conversion to 7-11 mc. For the operator already equipped with 50 mc receiving gear it would be very convenient to make the first *if* 50-54 mc. This would allow him to feed the output of the 432 mc converter into the six meter receiver and thus get going with a minimum of new equipment. Mention has been made of the importance of a low noise first *if*. Assuming the frequency is 50-54 mc, the typical converter might employ a cascode amplifier using two 417A type tubes or a 417A/6AJ4 combination. If the budget won't allow the use of a 417A then two 6AJ4 or 6AM4 type tubes could be used. For best noise figure a pentode should not be used in the first stage of the *if* amplifier. A vacuum tube such as a 6J6 or 6AM4 might be used for the mixer, but at this frequency the diode mixer works as well, or better, and the construction of a mixer cavity for a diode is much simpler than one for a tube. There is one drawback to the use of a diode mixer . . . it is more easily damaged by excessive rf than a tube. Precautions should be taken to insure that the rf present at the converter input is nil or quite low when transmitting. A good coaxial relay will help fill this requirement. Something else to consider is rf present when a high power transmitter on another band is used, especially the two meter

band. The third harmonic rf present when the the two meter transmitter is operated could damage the diode mixer or rf amplifier tube in the 432 mc converter. One solution to this problem would be the use of a control system so that the 432 antenna relay operates when either the 144 or 432 mc transmitter is operated. Diode mixers require relatively little injection for good mixing. For a converter with a 50 mc first if the oscillator/injection string might be as follows: a third overtone crystal at 42.444 mc, 12AT7 oscillator/tripler, and 6AK5 tripler with output on 382 mc. The output of the last multiplier stage could be link coupled to the diode mixer cavity. The plate voltage for the 12AT7 oscillator/multiplier would be supplied by a voltage regulator tube. If this oscillator/multiplier unit did not supply enough injection, as in the case of a tube mixer, a grounded grid amplifier using a 6AJ4 or 6AM4 could be added between the 6AK5 tripler and the mixer unit. With a diode mixer this would be unnecessary. An injection amplifier would help reduce spurious responses, however. It is common practice to measure the diode current in order to arrive at the proper amount of injection. Mixer current should be on the order of .2 to 1.0 milliamperes.

The range of a 420 station may be up to several hundred miles, depending on the terrain, local weather conditions, and the equipment used. The most outstanding work thus far has been the one way reception of KH6UK, Hawaii, by W6NLZ, Los Angeles. Path attenuation is great when there is heavy rainfall. Local rainfall may increase antenna and feedline losses, too. If activity is low in your area it may be necessary to use prearranged schedules. Many stations operating on 432 use the two meter band for liaison, especially when seeking to work a new state or set a new dx record that might be possible during a good tropospheric opening. Watch for two meter stations calling "CQ any station with 420 gear." In QST the states worked column for 432 will give you a pretty good picture of coverage and dx worked in the various areas. In glancing over the 420 scoreboard in the current issue of QST we find the results in each call area as follows: First call area, eleven states worked in four call areas, maximum distance 410 miles. Second call area, twelve states worked in five call areas, maximum distance 360 miles. Third call area, seven states worked in three call areas, maximum distance 296 miles. Fourth call area, six states worked in four call areas, maximum distance 550 miles. Fifth call area, ten states worked in three call areas, maximum distance 600 miles. Sixth call area, one state worked, maximum distance 180 miles. Seventh call area, two states worked, maximum distance 180 miles. Eighth call area, seven states worked in four call areas, maximum distance 580 miles. Ninth call area, nine states worked in four call areas, maximum distance 608 miles. No listing for the tenth call area.



Top view of 432 mc. converter at A/W4HHK. Left to right along rear of chassis: power supply, oscillator/multipler unit, injection amplifier unit, mixer unit, and r.f. amplifier unit. Tubes along front panel are 50 mc. cascode i.f., second mixer stage, and cathode follower output stage. Note sub-assembly construction technique.

If the present power limit of fifty watts input were raised to one kilowatt it is barely possible that successful moonbounce work might be done on this band. In any event, if equipment equal to the best in use on two meters is employed, and antennas of equal physical size are used, outstanding dx may be worked on 420 mc under favorable tropospheric conditions. In fact, under certain conditions, the signal of a fifty watt 420 station may exceed that of a higher powered one on 144. Generally speaking, however, bending conditions on 144 mc have to be good enough for a solid voice contact before the same station can be worked on 432 using CW. Knowing your own frequency to within a few kc and the calibration of your converter/receiver combination are two important factors. Often stations will be scheduled who do not have the means of measuring frequency reliably on 420. Simple multiplication of the fundamental oscillator frequency (as marked on the crystal) is not enough. By the time an 8 mc frequency is multiplied fifty-four times to arrive at 432 an error of 1 kc at the oscillator frequency will result in an error of 54 kc at 432.

A round about way of checking the calibration of your transmitter or converter is to do the measuring at 144 mc. This, of course, assumes accurate calibration of the two meter gear. The two meter converter may be calibrated accurately by the use of a 1 mc crystal controlled oscillator/harmonic generator. The procedure is as follows: The one mc oscillator is zero-beat with WWV at 10 or 15 mc. It is loosely coupled to the HF receiver used with the converter, and as much coupling to the input of the two meter converter as is necessary to produce a detectable signal. The 144th harmonic of the 1 mc oscillator is tuned in on the converter/receiver. The crystal oscillator in the converter is then adjusted until the *if*

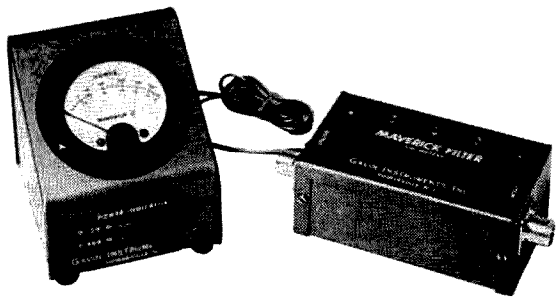
signal delivered to the HF receiver at, for example, 7.0 mc, is zero-beat with the 1 mc harmonic falling on 7.0 mc. After this, the sub-frequency of the 432 mc signal (144 mc) may be tuned in at two meters and the true frequency at 432 determined by multiplying by three. In order to hear the 144th harmonic of a 1 mc oscillator on a two meter receiver it may be necessary to accentuate the harmonics by inserting a diode and/or tuned circuit in the output of the oscillator unit.

The crystal oscillator in a 144 or 432 mc converter will drift a few kc when first turned on. In addition, as the oscillator tube ages . . . over a period of many weeks . . . the calibration may change a few kc. The converter calibration should be checked at regular intervals for reliable dial readings. As with any VHF receiver, a noise generator is very useful in adjusting for best weak signal performance. In the absence of one of these, a low-powered crystal controlled oscillator/multiplier unit may be used to good advantage. A steady test signal for those time consuming adjustments and cut-and-try work is invaluable. Such a signal generator might be set up across the back yard so that the signal is received on the station antenna. If it is low powered and well shielded it could be loosely coupled into the feedline to the receiver. If the device is conveniently mounted so that it may be easily connected into the system at regular intervals, a fairly reliable check on receiver performance can be made. It is even better if the antenna system is included in the check. A faulty connection, relay failure, or tube failure would show up that might otherwise go unnoticed on a band where signals are few and man made interference is not easily detected. The absence of regular signals for checking equipment performance could mean the loss of a new dx record.

These comments have emphasized the use of crystal controlled transmitters and receivers. If outstanding results are to be enjoyed, only the best possible equipment should be used. This does not prevent the newcomer from getting started with the more simpler gear. After the thrills of the first qso across town are experienced, the desire to work more stations at greater distances will develop, and thinking will progress to 4X150 amplifiers and the like. For more information on the subject you are referred to: The Radio Amateurs Handbook, published by the ARRL, Inc.; The VHF Handbook by Orr and Johnson, published by Radio Publications, Inc.; The Radio Handbook published by Editors and Engineers, Ltd.; VHF For The Radio Amateur by Frank C. Jones, W6AJF, published by Cowan Publishing Co.; and the VHF Amateur Magazine published by K2ZSQ. A rather complete bibliography on VHF material appearing in QST in recent years may be found on pages 182 and 184 of the October, 1959, issue of QST. See you on 432!

...A/W4HHK

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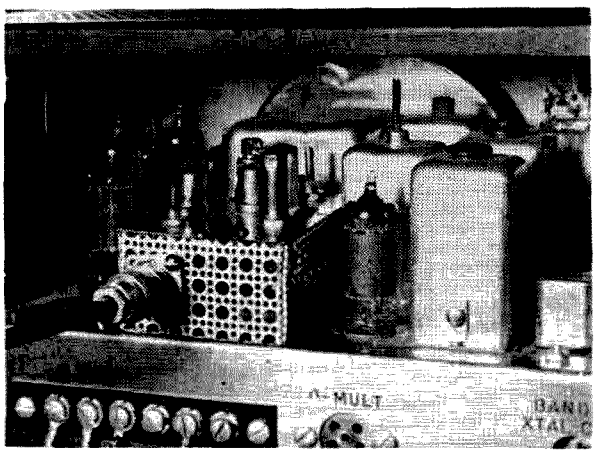
6M Nuvistor Plug-in Converter

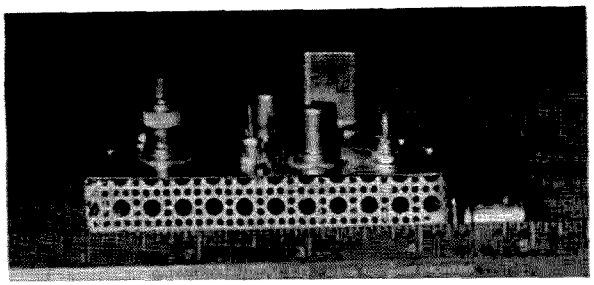
Capt. John J. Sury K8NIC/5

Photos by Ben Head K5HWF
City Photo Service, Abilene, Texas

Here is a gem I believe all you 6 meter boys have been looking for. A small compact 3 nuvistor 6 meter converter (2) 6CW4 and (1) 7587 which measures 2⅛" high over all, 2 inches wide, and 3¼ inches long, not including the coax connector. The largest item on top of the chassis is the overtone crystal. The author had in mind of developing a low voltage low current 6 meter converter which would fit into the crystal calibrator slot of his Drake 2A receiver. A separate converter, power supply, and a bunch of wires around makes things a mess, and causes entanglements. This converter has only one, the antenna connection. So if you are a owner of a Drake 2A or 2B, this is especially the project for you. The voltage is low, rf 55 volts, oscillator 40 volts and the mixer 90 volts, using not over 25 ma. total current, not including the heaters. Don't underestimate this little gem; it's hot and will stay with the best of them. This is strictly a straight forward design—no gimmicks to complicate the situation to get more gain or fancy it up. The nuvistor replaces the tube; the most expensive items are the overtone crystal and the 7587 tetrode nuvistor, but the results are very gratifying.

Let's get the building started. Follow the layout Fig. 2 and no problems will be encountered. Keep the wiring neat and the leads short as possible. Use insulating lugs for B plus and filament. A grid dipper should be handy to pre-tune the coils. The capacitance or the turns on the coils may vary from mine by a turn or two or a mmfd or two. Only one small shield is incorporated between the rf and





the intermediate coil. A piece of copper shim stock will do.

Take a sheet of brass 2X3-¼" about 1/32" thick and make the layout. Brass is preferred because you will solder the nuvistor sockets to the chassis. Drill all holes and shape the nuvistor socket holes to fit the nuvistor sockets. Install the sockets and solder them in around the edges. Install the crystal socket. Next take three slug tuned coil forms 3/16" in diameter (obtained at your local surplus or electronic store) and #28 HNC nylclad copper wire and wind the coils. L_1 is tapped for the antenna three turns from the ground. Solder on C_1 and tune for 50.5 mc or desired receiving frequency. Wind L_2 on a form and then wind L_3 over L_2. Tune the same frequency as L_1 with C_4 installed. You may increase C_1 and C_4 by decreasing the turns of L_1, L_2, and L_3. Wind L_4, install C_8 and tune to 43 mc. L_5 comes later. Take a ⅜" coil form and wind 40 turns of #28 wire on it for the primary for L_6 and on the ground end wind L_7 over L_6 with the same size wire. Shunt L_6 with C_{10} and C_{11} in series and tune to 7 mc.

Install coils as indicated on the layout. Solder shield in place between L_1 and L_2L_3 as indicated by the dotted lines on the layout (solder to brass in spots). Complete the wiring of the converter with care. Take a piece of approximately #24 solid hook-up wire and make 1½ turns over L_4 loosely. Take the other end and solder to pin four of the 7587 nuvistor socket. This is all the oscillator coupling that is needed to the mixer. For neutralization of the rf a choke made with 28 turns of #28 or 30 nylclad wire over a ½ watt 1 meg resistor is a good starter. You may have to decrease or increase the turns to neutralize the rf.

Take a piece of 10-¾" X 1⅝" do-it-yourself aluminum, obtained in any hardware store, and form the bottom part of the chassis.

For Drake 2A or 2B Owners

Form the bottom chassis and fit into the crystal calibrator slot of the receiver. Cut a piece of fiber 1-15/16" long, ⅝" wide and 3/32" thick. Obtain a four pin battery plug from your local electronics dealer that will fit the crystal calibrator socket. Install it to the fiber board and install to the bottom of the chassis. Refer to proper wiring of the plug from the Drake receiver handbook for the crystal calibrator. Then install the top chassis

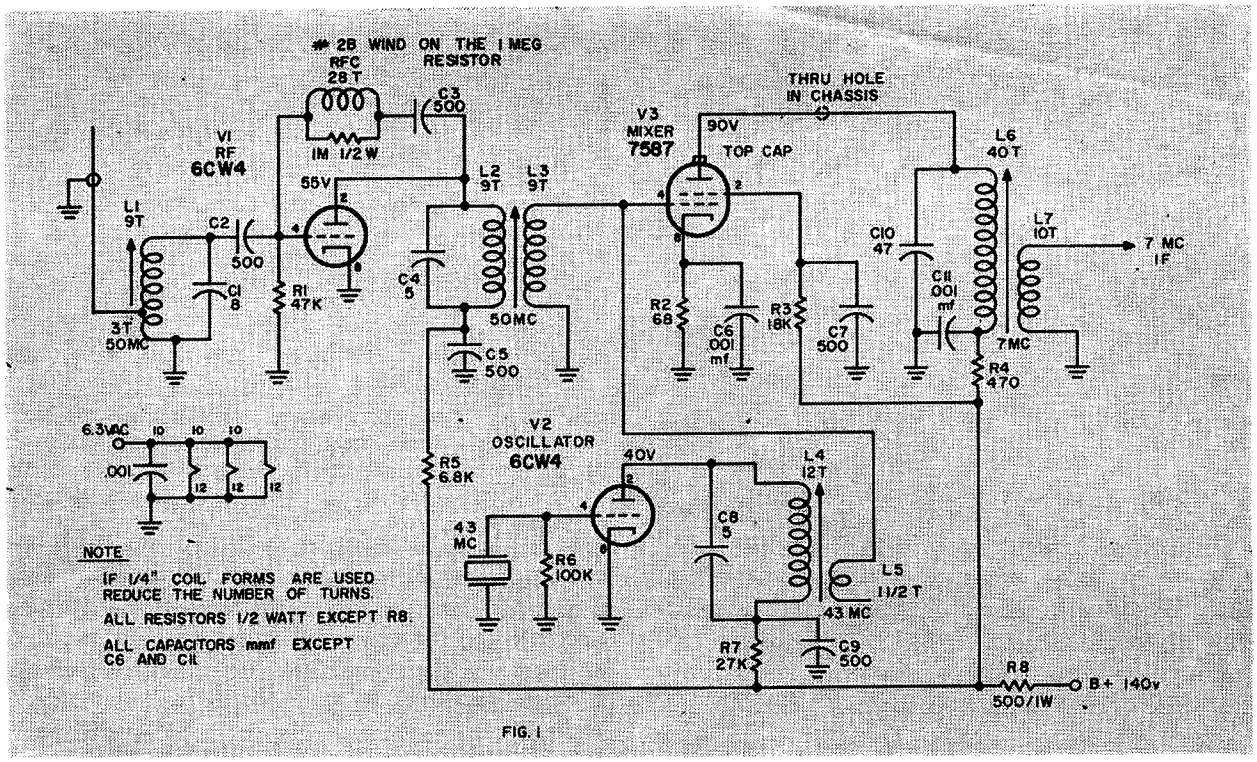


FIG. 1

to the bottom. Hook up the B-plus, filiment input to the antenna, and ground. It will be easier to align if the receiver is removed from the cabinet.

With the converter plugged in, turn on the receiver and crystal calibrator switch. Tune for maximum signal using a grid dipper or a signal generator not connected or coupled on approximately 50.3 to 50.5 mc. When you have it properly tuned the generator or dipper will almost peg the S-meter with the antenna connected. The noise level will be approximately 4 to 5 S-units. If the rf nuvistor breaks into self oscillation, take 1 turn off the RFC at a time until it stops. Then check for images.

You fellows with other types of receivers can install a coax connector or RCA female phono plugs to go to the antenna and receiver. Take B plus and filament from the receiver. Do not exceed 125 volts on the 7587 plate or she will blow. Desirable voltage on the 7587 is 90 volts for the best signal to noise. Use a larger dropping resistor R_8 if needed to drop B-plus on the 7587. The other nuvistor's B-plus will be taken care of automatically.

Don't let the size fool you. It outperforms the author's commercial converter. This should be a terrific project for the printed circuit ham. Build this gem and get the kicks I got out of it with the first local and the first DX.

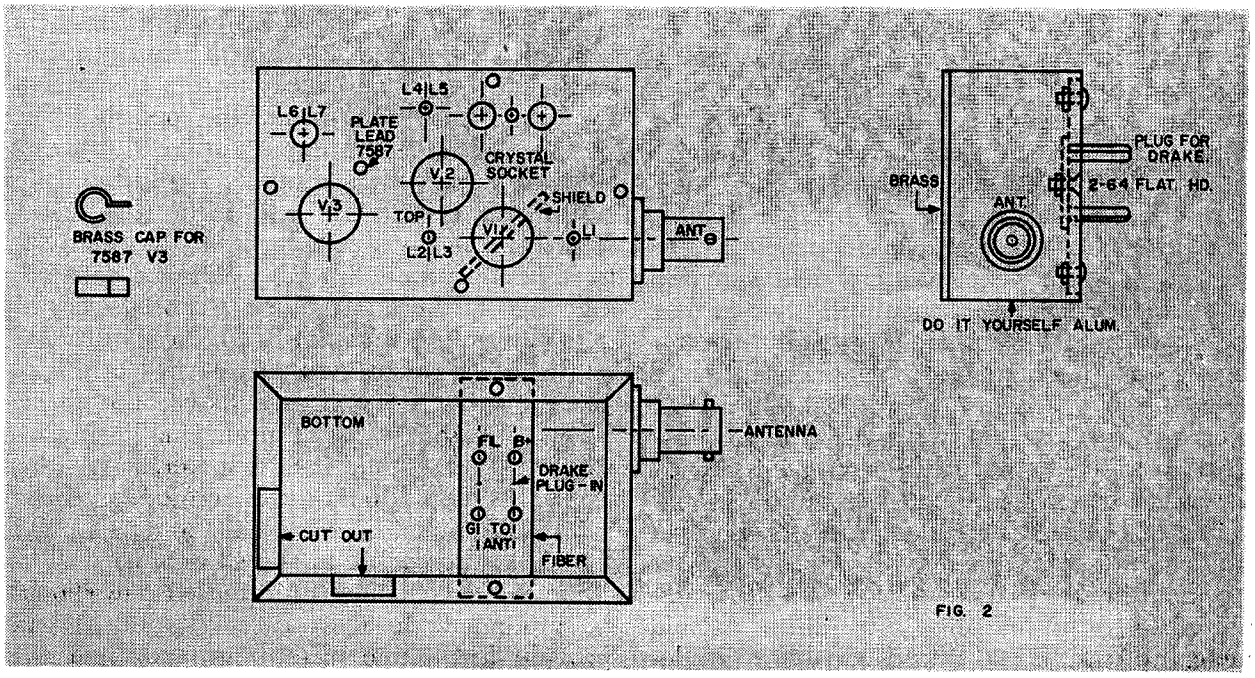


FIG. 2

Hints on VHF Construction

Larry Levy WA2INM
1114 East 18th Street
Brooklyn 30, New York

A LARGE number of VHF circuits built do not always function properly the first time. Usually the stage or stages have a tendency to oscillate either at the operating frequency, or some other frequency, mostly in the UHF region. This can be traced to improper bypassing, faulty layout, inadequate shielding, improper neutralization, the wrong type of parasitic suppressors, and numerous other causes. It can be any one or a combination of the common causes. Another problem is lack of drive or shortage of drive. This can be caused by not enough power input to the multiplier stages or improper coupling.

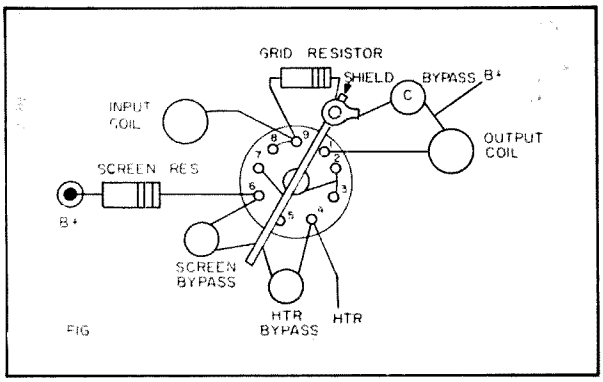
Bypass Condensers

At VHF frequencies, there are a large number of bypass condensers that do not bypass. The self-inductance of the condenser becomes large enough to act as an rf choke. The highest frequency that a condenser can bypass is the frequency at which the condenser is resonant. To test the resonant frequency of a condenser short the leads together by soldering to a copper sheet, the tip of a beer can, or any other similar sheet of metal. The leads should be the length that is going to be used in the circuit. A grid-dip meter can be used to determine the frequency. If the frequency is near the operating frequency, discard the condenser for that purpose and frequency. At two meters the majority of the commonly found .001 condensers are inadequate. A superior unit can be made by connecting two 300-500 mmfd condensers in parallel using the shortest possible leads. This gives a bypass condenser with the same capacitance but with half the inductance. (Since the inductances of the two condensers are in parallel they are halved.) As the frequency increases, the capacity required to bypass effectively decreases. At two meters a 700 or 800 mmfd capacitor is adequate. About 400 or 500 mmfd will do on 220 mc. For use on 200 mc, a very effective condenser can be made from two sub-miniature 200 mmfd ceramic discs. On six meters most of the common .001 ceramic discs work very well. On the higher bands one extremely effective bypass condenser is the button variety. A well constructed silver mica button should be effective well upward of 420 mc. It is recommended that these be used in ultra high gain circuits. In most other cases the paralleled ceramic discs will work. For bringing leads out of a chassis, a feed-through condenser should be used. This becomes doubly important in a transmitter with a large number of multiplier stages, as signals from these stages can cause considerable TVI.

Layout

The unit should be planned so that all the leads are as short as possible. If possible, a receiver or chain of frequency multipliers in a transmitter should be laid out in a straight line. A shield should be placed across the socket to isolate the input from the output. This becomes exceedingly important in a straight-through amplifier. All grounds should be made to the chassis with the shortest possible leads. If the socket has a center pin, try to avoid returning all grounds to that point and connecting them to the chassis with a short length of wire, as voltages common to the input and output can develop across that wire and cause instability. It is permissible to use the shield across the socket as a ground in some instances. If the shield is of a material that tins easily, it should be tinned across the entire shield and soldered between the two screws that hold the socket to the chassis, as well as through the center pin. All unused pins should be grounded. In most cases the shield will provide less inductance to ground than the

leads of the parts, unless the parts are at the pins near the screws that are used for ground points. Fig. 1 gives a typical layout for a 5763 amplifier. The top of a beer can is one of the best materials available for shields as they are usually copper-plated on one side and tin-plated on the other. The tin side takes solder easily and should be used on the side where most of the soldering is to be done. The rest of the can is excellent for making larger shields.



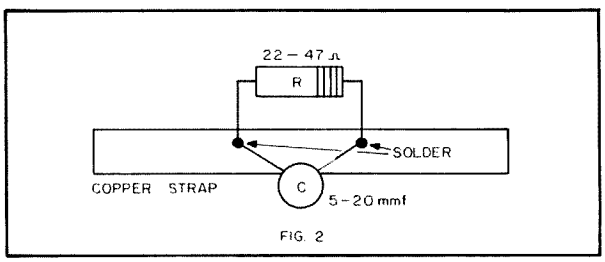


FIG. 2

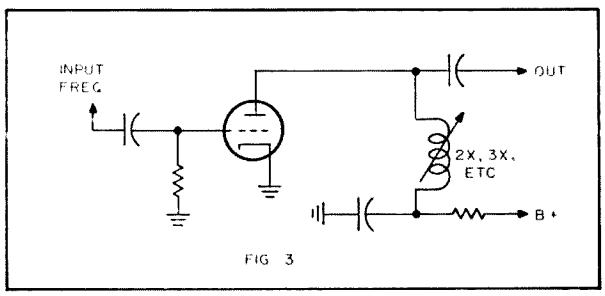


FIG 3

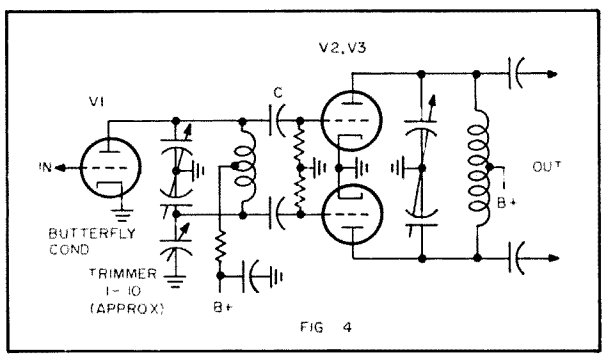


FIG 4

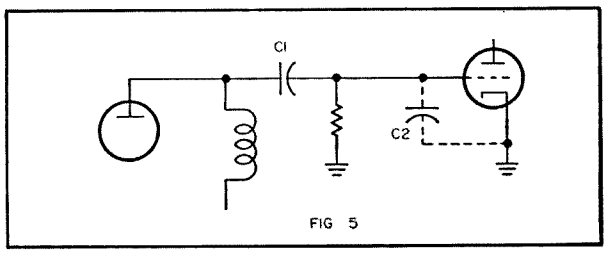
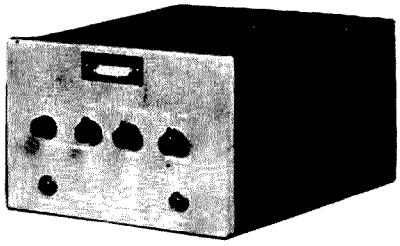


FIG 5

Neutralization and Parasitic Suppression

Oscillation in a final amplifier can be of two general types. The first type is parasitic oscillation and is usually at a frequency that is quite different than the operating frequency. If the oscillation is near the operating frequency, it is usually due to improper neutralization. One type of neutralization that works quite well is the use of a stub to cancel the grid to plate capacity of the tube. A hole is drilled in the chassis near the grid pin and a stiff piece of insulated wire is brought through the hole and connected to the grid pin. The wire is placed near the plate of the tube and the length and position are adjusted for minimum feedthrough. In push-pull circuits the stubs are crossed so that the grid wire of one tube is near the plate of the other. The position of the wires is adjusted for minimum feedthrough. In some circuits (single ended) capacity bridge neutralization is used, but this is usually trickier to adjust. Parasitic suppression is accomplished by placing a suppressor in series with either the grid or plate leads to break up parasitic resonance. The type of parasitic chokes used on the lower frequencies do not work well on VHF because their inductance is a good part of the inductance of the resonant circuit. Usually they cause more parasitics than they eliminate. A recommended type is a copper strap (usually the flexible plate lead) with a resistor and condenser connected in parallel across a small section of it, see Fig. 2. This is usually sufficient to lower the Q of the parasitic circuit enough to prevent oscillation. Another type of oscillation encountered is when the grid and plate circuits have some common resonant frequency in them, as could be caused by two similar rf chokes, etc. The tube will oscillate at a frequency at which the chokes are both resonant. This can usually be prevented by using two different type chokes for plate and grid. If that is impossible, a resistor of about 500 ohms can be connected in parallel with the choke (in push-pull circuits) to lower the Q. Another cause of oscillation is inadequate bypassing of the screen when tetrodes are being used. If possible avoid using rf chokes in the screen leads of tetrodes. It is usually advisable to use a button condenser to bypass the screen or with tubes like the 5894, 6360 and many others, to leave the screen unbypassed. It usually helps to mount the tube socket with the metal rings above the chassis if octal tubes are being used.

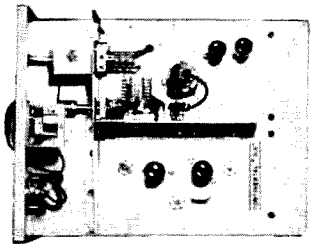
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Frequency Multipliers

In the design of a transmitter the initial frequency is usually around 8 mc and this is multiplied to the desired frequency. The simplest type of multiplier is shown in Fig. 3. Pentodes can be used. Dual tubes are excellent for multipliers as they save considerable space. This should not be done at the sacrifice of power. The final multiplier stages should have more than enough power to drive a final or driver. All things being equal, the output decreases directly with the amount of times the frequency is being multiplied. At the higher frequencies plate losses reduce the output even more.

One idea for a 6 meter rig is to use a 6AU8 driving the final in a power class of about 20 to 50 watts. The pentode section is used as an oscillator-tripler and the troide doubles to 50 mc. An arrangement like this should have adequate drive for a 6146 or similar tube. For 2 meters the 6AU8 could drive a 6360 as a push-pull tripler to 144 mc. A phase inverter of the type shown in Fig. 4 works quite well. That type of circuit could also be used to multiply 72 mc to either 144 or 220 mc. The phase inverter circuit can also work on driving push-pull finals. Coupling capacitors C will be discussed shortly. A 6360 tripler should have adequate output to drive a 5894, 829B, 832A, etc., on two meters or a 6360 buffer on 220 mc. When working at higher frequencies plan the driving power with an extra 10 times the driving power stated in the tube manuals, as it is extremely difficult to get drive otherwise. Coupling condensers tend to be a problem as using large coupling condensers causes losses due to the series inductance of the condenser and smaller ones cause losses due to the voltage dividing action of the input capacity of the tube (C2 Fig. 5) and the coupling capacitor (C1). The value used should be a compromise. If the input capacitance of a tube is 5 mmfd and a 5 mmfd coupling capacitor is used, ½ of the drive voltage will appear at the grid. This should be avoided whenever possible by using larger coupling condensers.

Parts and Materials

The success of many circuits is attributed to the type of parts used. Tube sockets should be of a type that have low loss and low inductance. Wafter sockets have very low inductance leads and their insulation is fairly low loss. This will contribute greatly to stable operation. Tubes used in VHF work should be

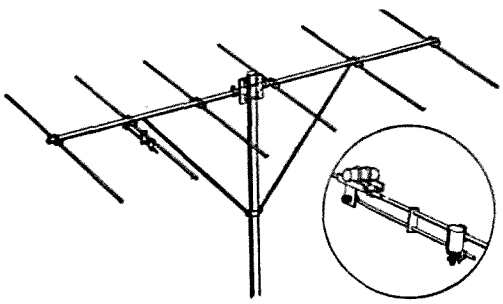


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those designed for VHF work as most of the types used on the lower frequencies perform miserably in the VHF range. This applies more to transmitting tubes than receiving tubes. Coils should be air-wound if possible and wound with bare wire. A good grade of coil dope, such as GC "Q Dope," should be used if any is going to be used at all. Slug tuned coils should have slugs designed to work at the frequency at which the coils are being used. The type of slugs used on the broadcast bands and below 30 mc are completely unsuitable for VHF work. Brass slugs decrease the inductance of the coil and are usually used at 2 meters and above as it makes the coil easier to wind. Stray inductance in leads should be avoided. VHF gear usually does not look neat because some of the neat wiring in which parts are parallel and at right angles to each other requires extremely long leads which make that type of wiring unsuitable for VHF.

These are the most common pitfalls to be avoided in VHF work. There are many more, but these are the main ones. If a rig is built using this as a guide, very little trouble should be encountered with getting successful results.

. . . WA2INM

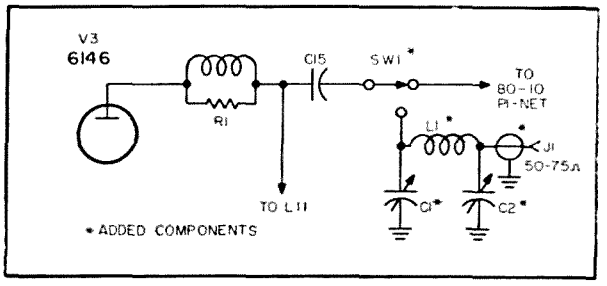
Putting the Eico 720 on Six Meters

James Beckett WA2KTJ
344 Park Avenue
Corning, New York

NO doubt there are many of these fine transmitters being used by Novices and Generals. So, in case you went from Novice to Technician or would just plain like to get on six without too much effort, this addition to the 720 will do the trick.

The oscillator of the 720 will oscilliate with an 8 mc crystal if the oscillator coil L1 is slightly readjusted. This 8 mc output will then triple to 25 mc in the buffer multiplier with the bandswitch in the 10 meter position. In turn, the 25 mc output is doubled in the final to 50 mc. The latter is accomplished by the addition of a separate pi-net output circuit.

Mounting of the components at first seems



a problem, but with careful application of dexterity, the trusty hack saw will solve the problem. A panel 6½" wide by 4½" high is cut from the right side of the top cover. Replace the top cover and establish the proper position of the newly cut panel. Mark this positioning so it may be relocated after the top is removed. Remove top and relocate panel with flange resting on chassis. Mark two or three places on the flange for drilling holes for the bolts that will hold the panel. After this is done replace panel and mark the holes for the chassis. Drill same. Placement of the components on the panel will depend on the parts you use. In my case the switch is on the left of the panel, the plate tuning capacitor in the middle, the antenna loading capacitor on the right, and the SO-239 bottom right. The parts may be juggled around so that everything clears.

The only change in the original circuitry suggested is to remove L 17, the parasitic suppressor, and replace with a 47 ohm 2 watt resistor, over which, wind a two turn coil of number 18 tinned wire.

Coil L1 must be readjusted to produce about 3.5 ma drive with the bandswitch in the ten meter position. This will be the normal position of the bandswitch while operating six meters. (Some loss of drive may occur while on ten meters, in that case L1 may need to be reset while on ten). Use an 8 mc crystal in this adjustment.

Tune up follows the same procedure as the other bands except that the bandswitch must be on ten as mentioned and switch S1 in the six meter position. Connect a good antenna with a low SWR and you're in business.

This modification has been in use for over a year with very good results. All in all it's a very inexpensive conversion.

Parts List

C1—50 mmfd variable—Bud 1853
C2—250 mmfd variable—Lafayette MS-214
L1—4½ turns number 18¾ in. dia. (resonate with C1 at 50 mc by spreading or compressing turns)
J1—SO-239 coaxial connector
SW1—One pole, two position, ceramic switch—Centralab 172C
R1—47 ohm 2 watt resistor with two turns number 18 wound on it.

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Finding True North

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Andy Wisler KH6BW

BACK in Volume 1 No. 2 of 73, the November 1960 issue, Mr. Calvin R. Graf W5LFM was the author of a short article on an excellent method of determining True North from your location by means of vertical alignment of the North Star, Polaris, with Eta of Ursa Major—the last star of the handle of the Big Dipper, and Epsilon of Cassiopeia, the End star of the "W." The illustration accompanying the article showed Polaris directly below the Pole, indicating True North. This position of the North Star also is known as the Lower Culmination. When the North Star is directly above the Pole, it also indicates True North and is known as the Upper Culmination. These events occur every day and are approximately 12 hours apart.

For various reasons, such as living too far South, on the wrong side of a hill, a wooded area, or due simply to low lying clouds on the horizon, you may not be able to line up all three stars when they are in a vertical position and that beam or whatever it was that you needed to know True North, project will have to be postponed.

Life can be made simpler though. For 35 cents a 17 by 11 inch chart can be obtained which tells us all sorts of things that take place in the sky during the hours of darkness, or to be more specific from 4 P.M. to 8 A.M. your local time. It is called the "Graphic Time Table Of The Heavens—1962," and is obtained from the Maryland Academy of Sciences, 400 Cathedral St., Baltimore 1, Maryland.

To find True North you determine the Local Standard Time for either the Upper or Lower Culmination for the date desired. A simple correction for locations east or west of the Standard Time Meridian, minus or plus four minutes per degree of longitude is made. Most of the larger cities are already given in the chart. At that time you look at Polaris. You are looking at True North. I should point out though, that these culminations can occur too near sunset and sunrise to be visible easily during the summer months, say June and July.

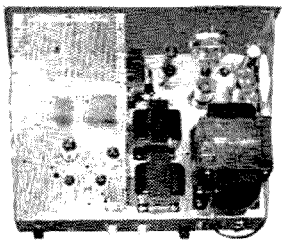
Many other interesting events can also be determined from this chart, such as moonrise and moonset, sunrise and sunset, rising and setting of the planets, etc. However, if you are working on Moon Bounce projects, a more sophisticated means of obtaining moonrise and moonset time during the day from 8:00 A.M. to 4: P.M. must be available.

. . . KH6BW

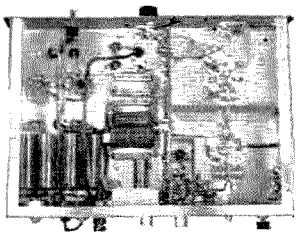
Modifying the Modifications on the Modified HE-35

It seems to me that the HE-35 that I modified (See 73, Feb. 1962, P. 54) was a very unusual one in several ways. By this, I mean that two of the bugs that seem to be quite common were non-existent in my transceiver. By borrowing one that had these defects, I was able to work on and solve the problems. The problems are in the oscillator circuit, one of them being a drift and change in frequency during mobile operation, and the other being a sort of oscillation caused when a strong signal was tuned in with the audio gain turned up somewhat. This situation became much worse with the noise limiter on. For anyone that operates mobile, as well as someone who uses the rig on ac, this can get to be annoying, to say the least. To say the most, it can get extremely frustrating. Fortunately,

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these problems can be corrected with a minimum of effort and expense.

The oscillation problem is caused by what is the equivalent of a microphonic oscillator coil. The coil itself is not really microphonic, but the leads near the oscillator coil tend to vibrate when there is any appreciable volume coming from the speaker. The leads do not have to be in the oscillator circuit themselves, just near the oscillator coil, leads to the coil, tuning condenser, or associated circuitry being sufficient. The cause is really quite simple—when the leads vibrate, they cause a change in capacity, small as it is, with the leads in the oscillator circuit. This results in the varying of the oscillator frequency at an audio rate. To put it plainly: frequency modulation. When this reaches the detector, it is detected and amplified like a regular signal. When it reaches the speaker, it causes the leads in the oscillator circuit to vibrate and so on through the cycle. The result is an audio oscillation every time a strong signal is tuned in. The cure is simple—a thorough coating of the oscillator coil and leads in the vicinity with a layer or two of "Q Dope"

The other problem is caused by a variation of the plate voltage on the oscillator tube. The addition of a voltage regulator tube will eliminate all drift of this type. An OA2 is mounted under or on the chassis, wherever there is more room, and connected to the plate supply of the oscillator tube. This requires a modification of the previous modification Remove the 5k resistor going to the B plus (See Fig. H, P. 58, Feb. 1962 issue of 73 Magazine) and connect a 3k 2 watt resistor in its place. From the junction of the 3k resistor and the 5 mfd filter, connect a 5.1k 2 watt resistor to the anode of the VR tube. From the anode of the VR tube, connect a 5.6k ½w resistor to the plate of the oscillator tube, using this in place of the 10k resistor used previously. The 3k resistor should be connected directly to the cathode of the rectifier instead of the normal B plus connection. Doing this will improve stability in two ways—1: by eliminating voltage changes caused by variations in plate current as AVC is applied and 2: by leaving the oscillator running continuously. The changes are shown in Fig. 1. These improvements make the receiver considerably more stable than it was before and can be done in not much more time than it takes to read this article.

. . . WA21NM

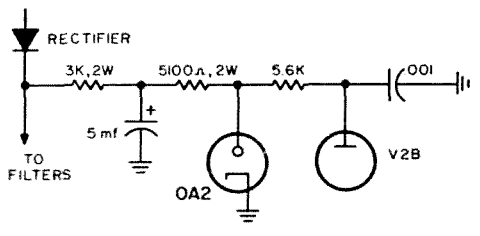
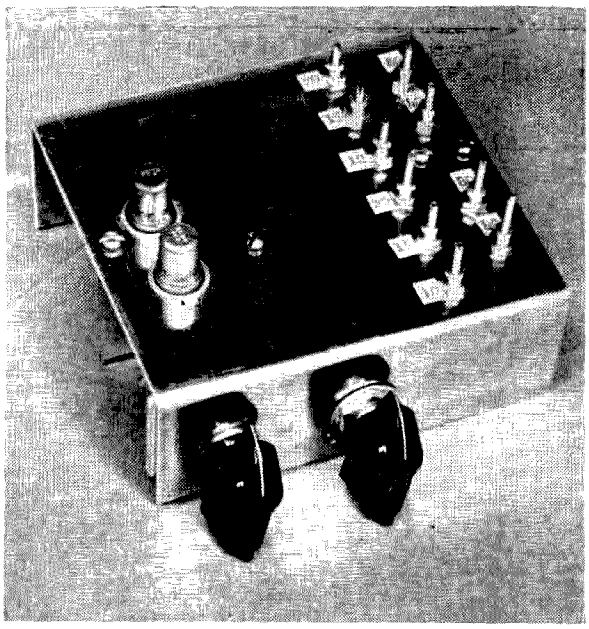


FIG 1

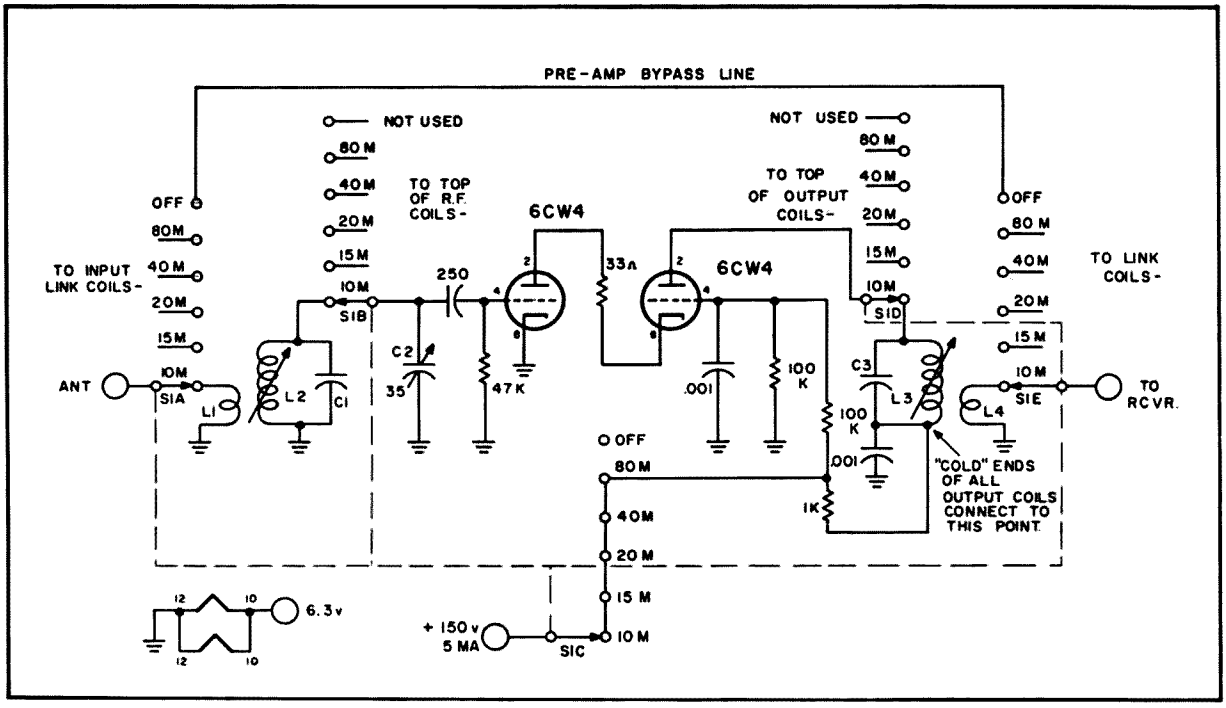


All Band Nuvistor Pre-Selector

Fred B. Cupp K8AOE

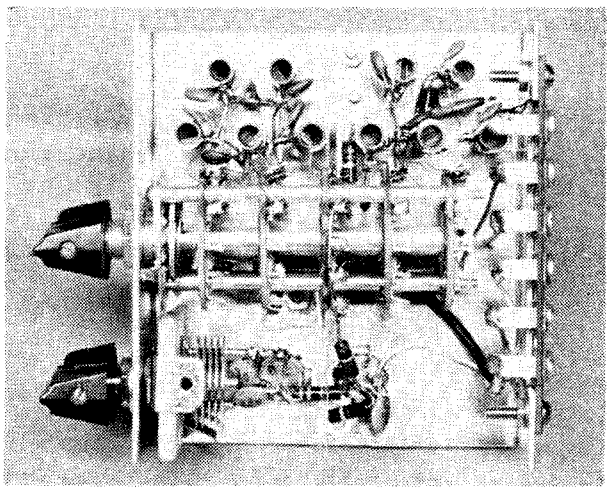
THE day will probably never come when a ham is completely satisfied with his receiver. Also many of us in the ham fraternity seem to be suffering from the same trouble, that is, lack of green stuff. As a result many of us struggle along with equipment which we realize has shortcomings in one respect or another. Consequently, we see articles in 73 regarding ways and means of improving the receivers that we have. The subject of quiet but efficient mixers was covered in 73 some time back, and judging from the reports sent in by the readers, that twin triode mixer was just what the doctor ordered.

I was quite skeptical of trying the Nuvistor on the lower frequencies. The arguments usually presented are that a well designed pentode rf stage will be quieter than the noise level picked up by your antenna so any further improvement in noise figure is frosting on the cake. The catch to this whole thing is the phrase "Well designed pentode, etc." However, I decided to give it a whirl, and I must say I was pleasantly surprised with the results. The increase in sensitivity was nothing short of astounding, although this is not of any great advantage unless you are using an S-38 or something of that ilk. The biggest advantage was the vast improvement in image rejection. My receiver happens to be a Knight R-100, which is quite adequate as a tuneable *if* since I operate VHF only. In listening



around the lower frequencies, I had come to the conclusion that the image rejection was nothing fabulous, and on 20 meters or more it became almost non-existent. Switching this pre-selector in and out of the line causes the images to drop right out of the picture. Also, don't neglect what this increase in image rejection can do to help lick the noise. Any noise at the image frequency will come right on into the mixer and help cover up that weak one you wish to hear. The better the image rejection the less image noise or interference will get through.

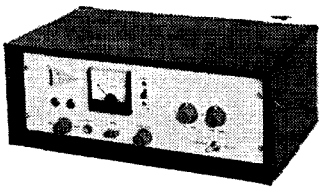
From the electrical standpoint there is nothing new or unusual about the pre-amp. It is the standard old cascode circuit which has been around for years. A purist might wish to neutralize the amplifier, but this was omitted in order to simplify the bandswitching circuits. A pre-amp bypass line was provided in the OFF position of the switch for obvious reasons. The heaters remain on at all times and B+ is switched to kill the pre-amp when not in use. Power can easily be robbed from the receiver's power supply. Don't worry if your receiver has regulated 105 instead of 150 volts. The Nuvistors won't know the difference. The Centralab #1017 bandswitch has eleven positions available, so if you wish to add more coils and have additional bands available, go right



ahead. For VHF use, the output link, L4 should go directly to the appropriate converter, and the output of the converter brought back to the proper contact of S-1E. In this manner you may have 80 thru at least 2 meters available at the turn of the switch, without all the plugging and unplugging of converters and power supplies. Naturally if you have separate antennas for the VHF bands they should bypass S-1A and go directly to the link on the coil in use. Although this pre-amp has not been used above 2 meters, the nuvistors are quite capable so you can experiment

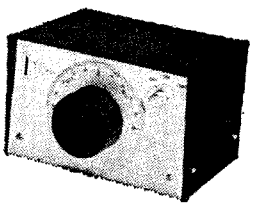
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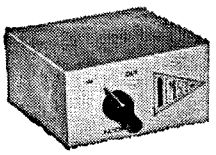


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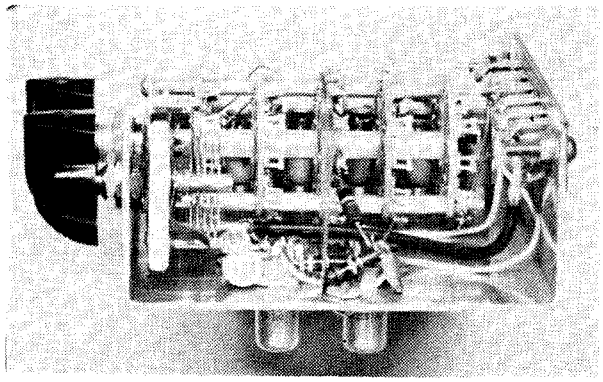
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with some hairpin loops right on the switch contacts for even higher frequencies. Don't forget to set the trimmer, C-2 to minimum capacity or you'll never make it.

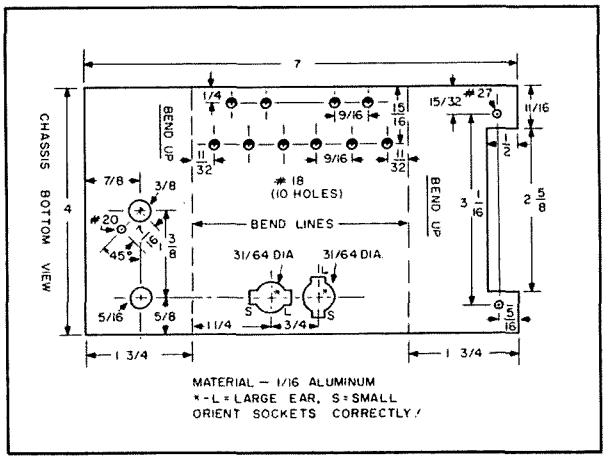
Many of the physical layout details can be seen in the underside photos, however the necessary dimensions are given in the chassis layout, Fig. 2. The two sheet metal shields which separate the input and output stages have not been detailed and should be fitted after all the other parts have been mounted. They are quite necessary, so don't eliminate them or you'll have an unstable VFO for your efforts. After all the holes have been drilled, bend up the two ends to form the chassis. Make sure you bend them the right way or you'll have a nice conversation piece. The Nuvistor sockets are placed in their respective holes, and the tabs bent over and peened with a drift punch.

Wiring the nuvistor stages themselves is very easy as all parts go point to point. The bandswitch is another matter. The task is somewhat simpler if you solder some pieces of bus bar to the switch contacts before mounting it (S-1B and S-1D only). The jumpers on the B+ wafer, S-1C may be installed before mounting the switch. The switch sections are designated S-1A thru E starting at the front panel end. The coils were all wound starting at the open end of the coil, which is the "hot" end in all cases, and the links were wound over the bottom or "cold" end. A ground lug was mounted under each of the 15 meter coils and is used as a common tie point for all of the links. The capacitors are mounted on the terminals on each coil.

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After completion, grid dip the coils to their approximate frequency and try it out. The slugs may then be adjusted to exact frequency. There will be more than enough gain, so the coils may be stagger tuned for each band. VHF coils mounted on the switch contacts (not shown in the photos) may be adjusted by squeezing or spreading the turns.

In use, the Pre-selector will add enough gain that cross modulation may become a problem in congested areas. Running your receiver at low rf gain should help this condition. If it is still a problem, an rf gain control may be added in the cathode of the first Nuvistor. A 5K pot bypassed with a .005 mfd capacitor should fill the bill.



Since writing the above, I went back to the bench and tried the Pre-selector out again with both an NC-98 and an S-38. As mentioned earlier the main advantage was the improvement in image rejection. The additional gain was necessary only on the higher frequencies with the NC-98, but on the S-38 it made the difference between hearing signals on all bands or hearing only mixer noise (with 60 cycles). I hope you feel as I do that the Pre-selector puts a lot more steam in your receiver for a lot fewer bucks than trading for a new "sooper 17" at several hundred extra cash. Thanks to John Yeagle, K8MSB for his help on the circuit drawing and layout. . . . K8AOE

Coil Table

BAND	L_1-L_4	L_2-L_3	C_1-C_3
80M	9T	45T	130 PF
40M	5T	27T	91 PF
20M	4T	17T	25 PF
15M	3T	15T	15 PF
10M	2T	11T	10 PF

Wire Size—#32 Enam.

Misc. Parts

Coil Forms—C.T.C. LSM-E
Bandswitch-CRL—1017
Terminal Strip-Cinch 17-6
C_2-Hammarlund HF-35
Nuvistor Sockets-Cinch 133-65-10-001

Transistorize that Meter

C. L. Henry
1910 Kirby Avenue
Chattanooga 4, Tennessee

ONE very obvious application of transistors is in dc amplifiers. The low weight and simple circuits make transistor amplifiers truly ideal. To narrow the application further, dc amplifiers to increase meter ranges are a logical step. Such amplifiers can make possible a 0 — 0.1 microampere (full scale) meter that is rugged enough for any type of field operation. Pocket size VTVM's are also a possibility. Think of having a VTVM in your pocket on outside calls!

Rugged meters, such as 0 — 100 microamp can be used. In most cases a single small battery will supply power for many months. Potting in epoxy is possible, giving greatly extended service life and freedom from moisture or atmosphere conditions.

However, there is another side to the picture. We all have read about temperature effects on transistors, but until you try a dc amplifier you cannot fully appreciate it. To quote one electronic authority, "transistors are better thermistors than thermistors!" And this is literally true. In fact the percent of change with temperature is greater with a transistor than with a thermistor. Even with this objection it is still possible to build a practical circuit. Another troublesome feature of a transistorized dc amplifier is that the internal resistance of the circuit to be measured must be high. We can avoid this difficulty, however, by limiting our measuring to very small currents, such as 1 microamp.

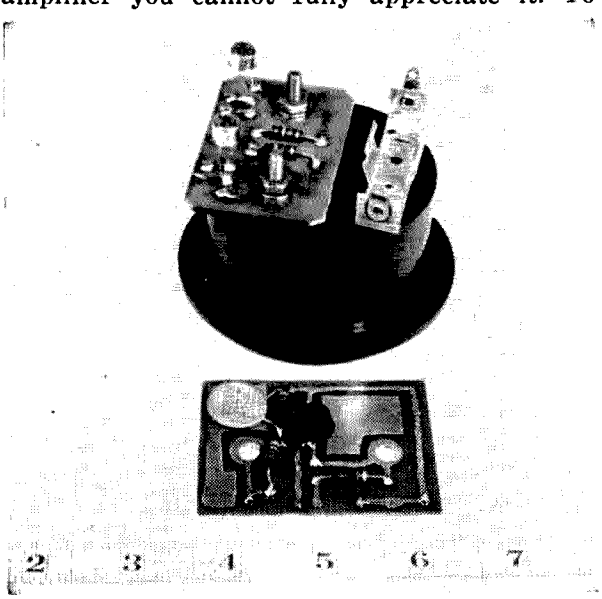
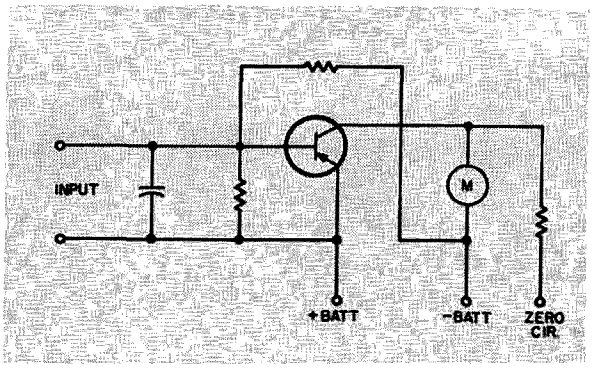


Fig. 1. Two transistorized meter amplifiers. The top amplifier uses push-pull transistors to eliminate the temperature effect, and also has a self-contained battery. The bottom board is used with a 1.0 ma meter which is not as sensitive to the temperature effect, and power for it is tapped off the circuit in which it is used.



Fig. 3. The experimental wide range microammeter. The circuit fits easily into a three-inch meter case. The side of the case holds the power switch and the zero adjustment. An army surplus meter is used, removed from a teletype bias meter circuit, having a sensitivity of approximately one milliampere each side of center.

Even with these disadvantages, the transistor compares favorably with the vacuum tube. Considering the extra bucking batteries, the higher voltages required, and the necessary waste of a heater supply, you might wonder if the vacuum tube compares favorably with the transistor! However, the simple, re-



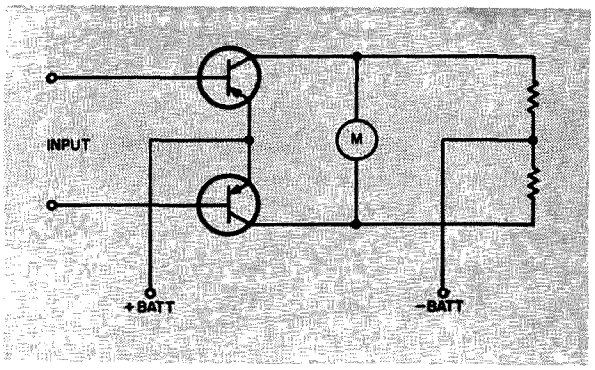


Fig. 2. Schematic of boards in Fig. 1.

liable operation of transistors is offset by the excellent input characteristics of the vacuum tube.

It is possible to build a transistor dc amplifier using only one transistor. Even though such an amplifier is sometimes desirable it has two troublesome features. The temperature effect can be partially compensated by proper use of thermistors. The zero signal current of the transistor must be bucked out also, and this requires several resistors and a potentiometer in some cases, and a bucking battery in addition, in others. Fig. 1 and 2 show the mounting board and schematic of a single transistor amplifier. The amplifier is constructed on a printed circuit board and designed to mount on the back of a meter directly.

A typical practical ciruit is shown in Fig. 3, 4, with the schematic in Fig. 5. This is a transistor dc amplifier, used to measure currents from 0.1 to 1000 microamperes. The amplifier is constructed on a printed circuit board which I constructed from a kit sold by Lafayette Radio Co. Although there is no advantage timewise in using printed circuitry on a single instrument, it is a very neat and practical construction method. Two four volt batteries are used in the circuit; one to power the transistor, the other to power the bucking circuit. Compare the simplicity of this circuit with a vacuum tube dc amplifier.

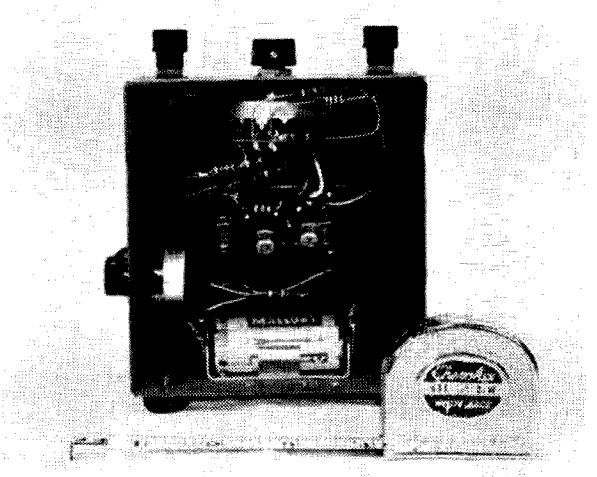


Fig. 4. Rear view of the wide range microammeter. The two mercury batteries can be seen mounted on the bottom of the case. The amplifier circuit is built on a printed circuit board and mounted on the back of the meter. The range calibration resistors are seen at the top of the case.

A low range microamp meter is certainly not a necessity for a service technician. However, in electro-biology, the measuring of very low currents is a frequent occurrence.

By using cascaded transistors, the amplification can be even higher. A reading of 0.01 microamp full scale is possible, using a circuit

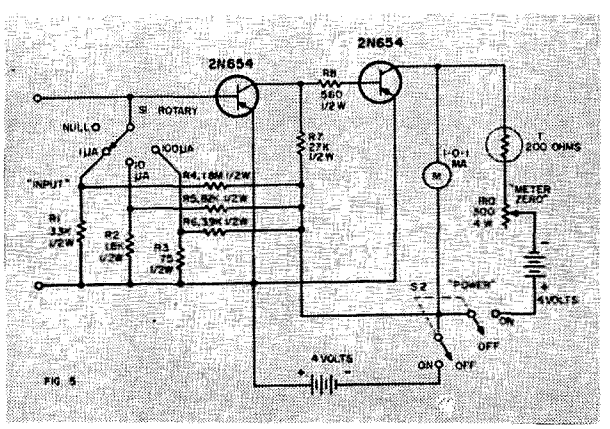


Fig. 5. Wide range micro-ammeter.

such as shown in Fig. 6. Cascade operation has the disadvantage that all your problems are multiplied. This is especially true of the temperature problem. Such a cascaded amplifier, with the input transistor in a parabolic reflector with infrared shield, makes a very effective heat detector. A dc to ac to dc converter circuit should be considered for more reliable operation if greater amplification is needed.

A further simplification of the circuit develops if push-pull operation is used. Although the number of transistors is doubled, the temperature problem is considerably reduced. The zero bucking circuit can be eliminated altogether, of course.

Figs. 1 and 2 illustrate a push-pull tran-

sistor amplifier. As the diagram shows, this is true push-pull amplification, and the meter will indicate zero with no input and the circuit balanced. The temperature effect will tend to cancel itself also if two similar transistors are used. It will be unnoticeable with a 0 — 1 ma meter, but it will be necessary to provide a balancing potentiometer for a zero adjustment when using a 0 — 50 microamp meter.

You will notice that the transistors are connected in a common collector type circuit. The reason for this is although the current gain is slightly less in this connection, the temperature variation is greatly improved.

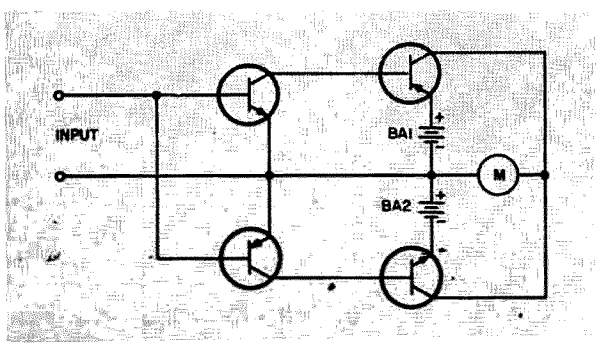


Fig. 6. Cascode dc amplifier.

Cascaded push-pull circuits are much more practical than single ended circuits, since the temperature compensation necessary will be substantially less.

A perfect application for a push-pull transistor dc amplifier suggests itself immediately. A pocket VTVM! What service technician has not wished for such an instrument?

It is in fact an easy matter to add a VTVM circuit to your VOM, if we consider the following items. First, the only advantage of the



Fig. 7. Front view of the modified VOM. The VTVM jack was originally the OUTPUT jack. The only mechanical work necessary is the mounting of the power switch on the top right side of the meter. Of course, if your meter is a different type, you will want to change the design to suit your requirements.

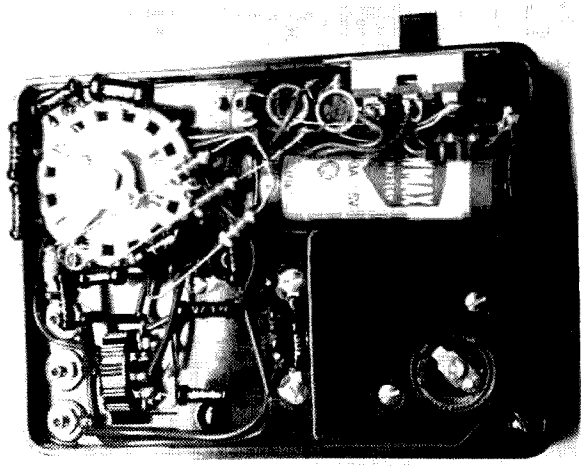
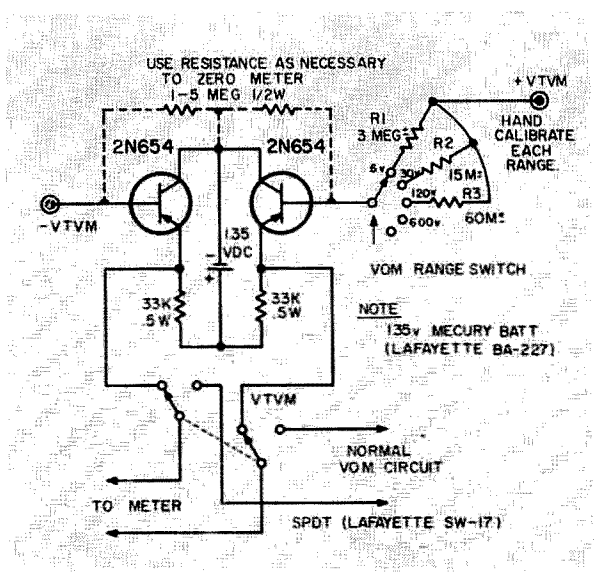


Fig. 8. Even though the space is very limited in this meter, the small size of the modification components allows easy mounting.

VTVM over the VOM (20000 ohms/volt) is in measuring dc voltages from 1 to 300 volts. This is easy to see if we examine the differences between these two types of meters. On ohms measurement, circuit loading is not a factor, and the meters are equal in their applications. The same is true in most cases on ac volts measurement, since the ac voltage source is usually of a low impedance. The input resistance of a VOM above 300 volts dc *exceeds* the input resistance of a VTVM, and will give *less*



SW17 is DPDT

circuit loading. Then to have a pocket size VTVM, it is only necessary to make the input resistance of the VOM comparable to the VTVM on the low voltage ranges. The transistor dc amplifier is perfect for this application.

It would be possible to outboard the transistor amplifier circuit, but this is unsightly and inconvenient. The transistor circuit can be easily fitted into the smallest of VOM's. The cost is low, and potting with epoxy resin

is possible for freedom from moisture, dust, and chemical fumes.

Figs. 7 and 8 show a VOM with a VTVM circuit added. This is a 10,000 ohm per volt meter, having a basic meter sensitivity of 80 microamperes, full scale. With most medium power transistors, a full scale reading of 2 microamperes is easily possible. This means, on the three ranges used, the input resistance will be 3 megohms. The next scale, 600 volts, has an input resistance of 6 megohms, and there is little advantage in increasing this for the majority of applications.

A double-pole double-throw switch was added to the side of the meter, to switch from VOM to VTVM operation. A notch is cut in the meter back, and the switch is secured in place with epoxy resin. No power switch is used, but even the small battery will last one to two years, so a power switch is really not necessary. The regular 1.5 volt penlite cell is removed from the meter, and two mercury cells used in its place, one acting as the ohmmeter battery and the other to power the transistor amplifier. The normal OUTPUT jack of the VOM was disconnected, and labeled VTVM. When using the VTVM, input is made to this jack and the added jack, J.

Added to the low cost and simplicity is the fact that the VTVM conversion does not affect the regular VOM operation on any range.

Although only two specific practical circuits are shown here, the features of transistor amplifiers are equal to a tremendous variety of applications. In some instances it may be economical to consider raising the sensitivity of a 100 microamp or 1 milliamp meter permanently through the use of potted, transistorized dc amplifiers, built directly into the meter case.

Rambunctious Radiations

James Ligon, W4KOC
Ex K2AQN, F7BB, 3A2AQ
2185 Hawthorne St.
Sarasota, Florida

OUR hobby of ham radio can certainly produce some bizarre and confusing situations. All of us have experienced at one time or another certain phenomena which defy logical explanation and which appear directly contrary to some of the accepted positions of Messrs. Ohm and Kirchoff.

When these confusing, and certainly at times frustrating, occurrences take place, we tend to blame "gremlins" or the "innate perversity of inanimate objects" (short name: IPIO, pronounced "Ippy-O"), or perhaps some other unscientific scapegoat. Now it is quite possible that an explanation can be found in Mr. Einstein's Theory of Relativity — at least in that part which upon analysis reveals itself as "it depends upon the point of view." His position seems to relate the human factor or "the innate perversity of animated Homo sapiens" (short name: IPAHS, pronounced "Eye-Pass") to the problem.

As a common and interesting example, let us consider the matter of transmitting antennas as related to power input and the effective radiation as evidenced by the signals at the receiving end.

Antennas have an interesting property referred to as gain. This is the plus or minus power factor of a particular antenna as compared with a reference radiator. Perhaps it would assist in our understanding if we simply say that some antennas are better or worse than others and that this difference is measurable in decibels.

The following are a few of my own documented experiences while in Europe operating with a 120 watt commercial transmitter.

I first used a long wire antenna. It was never actually measured electrically or physically but it was really quite long. This antenna worked well for European contacts but proved erratic when working W-land. I rigged a rope and pulley arrangement so that the end opposite the transmitter could be rotated about 90° and laid directly on Stateside. Voila! A rotatable long wire. Results followed somewhat the following pattern:

W2: CQ DX.

F7BB: Your signals 5x9 here in Orleans, France. Handle here Jim, tx 120 watts,

antenna rotatable long wire.

W2: Thanks for call. F7 not DX. Your signals 3/4 x 4/5 in New York. See you later. CQ DX.

Another W2: CQ DX.

F7BB: Your signals 5 x 7/8, etc.

This W2: Thanks OM. You are my first F7. Your signals 5 x 9 + + + here in New York. Please give address will QSL direct with round trip ticket to US.

These same phenomena held for practically all my W-land contacts — no matter the antenna — long wire, folded dipole, flat-top beam, Sterba curtain, etc.

This was a most confusing situation. I was discouraged and unhappy. As I was licensed as 3A2AQ, a vacation to the French Riviera and Monoco appeared in order.

In discussing my plans over the air, signal reports suddenly and without logical reason increased to 5x9 minimum. Further confusion!

In Monoco, the regular 3A2AQ antenna was a random length of wire which extended from the balcony of my fifth floor room down and across the small interior patio of the hotel, terminating about six feet above the ground.

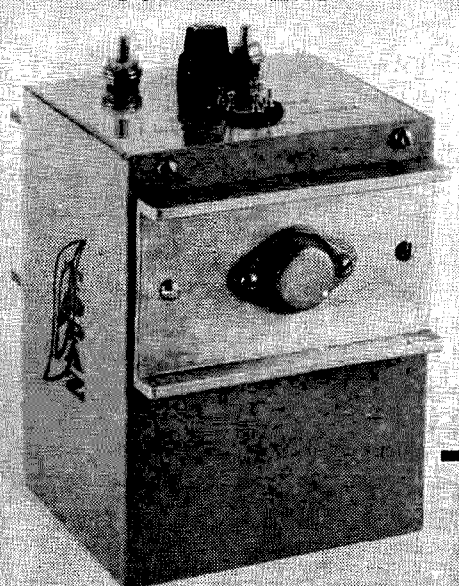
Prior to critical analysis of my operations, I knew that this antenna was to be far superior to those used at the home QTH. Stateside contacts indicated that I was "local broadcast quality in Siwash" and would I please listen for W Ooble Ooble two up or down as he was also reading me 5 and 9er. This same situation prevailed when I loaded the balcony railing and the door screen. No appreciable change in signal reports was noted when I loaded the bedsprings on 20 meters. I was very happy with these reports particularly considering the extreme difficulty I was encountering copying the KW beams.

Upon my return home, I found that the vacation had done wonders not only for me but for my rig and antenna system as well, for in discussing the trip (and one proposed to PX1-land) no report was less than 5x9.

There are undoubtedly numerous valid and informative conclusions to be gained from these experiences but I shall leave detailed evaluations to those readers who may be interested. My conclusion relates only to the human factor, as I see it, in Einstein's Relativity Theory and that is: regardless of sunspot activity, if the Ws want to work you, they will — it depends upon their point of view — IPAHS!

. . . W4KOC

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The Windom

IN radio's infancy a man named Hertz did wonders with things he modestly called Hertzian waves. In carrying out his early experiments he devised an antenna known (oddly enough) as the Hertz antenna. It worked well.

During the '30's a ham by name of Loren Windom, W8GZ, refined the old Hertz antenna, the modification becoming known as the Windom antenna. In principle the Windom was a Hertz antenna, fed off-center.

One of the first antennas I tried was a Windom. It worked well and was downright cheap to put up! I have always liked it.

Recently, though, I ran into some snags with one and consulted Windom. His advice was so sound, and it brought about such a marked change in the performance of my version of his antenna, I decided to pass along to others some of the things I've learned about the Windom.

In essence, the Windom is an off-center fed, harmonic antenna. That is, it will work with almost equal effectiveness on all frequencies lying in a direct harmonic relationship to the fundamental. It is simple to build, and inexpensive. If you have an old 80 meter dipole, it probably won't cost you a penny; if you have to go out and buy everything, it still will run only a few dollars.

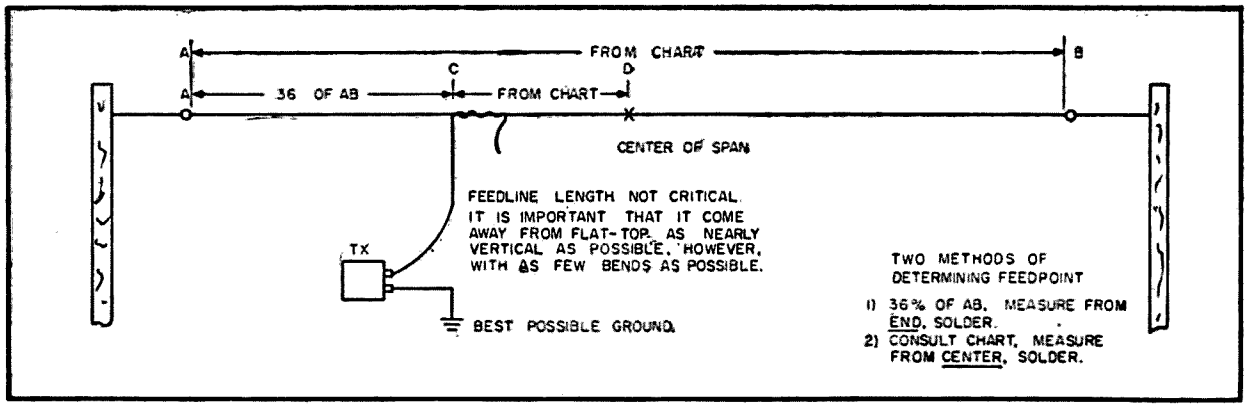
First, you will need two antenna insulators. If you run a few hundred watts, a couple of 5¢ egg insulators will be perfectly sufficient. Next, you will need a length of #14 wire. How much depends on the fundamental frequency to which your antenna will be cut, plus enough for the feedline. And that is absolutely all!

Before going further, it would be well to brush up on the characteristics of harmonic antennas. First, with just a small amount of investigation, it can easily be determined that all CW bands fall into perfectly related harmonics; that is, 3.5–7.0–14.0–21.0–28.0 mc. However, the rub lies with the phone bands: they do not fall into such perfect harmonic relationships. Therefore, if one operates mostly CW on the lower frequencies (and most DX chasers do) and mostly phone on the high bands, 10 and 15, the Windom is a perfect choice for an all-band antenna. Here's why: if the antenna is cut for, say, 3550 kc as the fundamental frequency, its harmonics will fall on 7,100, 14,200, 21,300, and 28,400 kc. In this manner, an operator will be able to chase that elusive CW DX on 80, 40 and 20, and switch over to phone for 15 and 10.

Therefore, in getting ready for construction of the Windom, choose first the fundamental frequency with particular attention to its harmonics. If you are careful in doing this, very little trouble will be experienced in all-band operation.

You say you want to be able to QSY a little? According to W8GZ, a frequency deviation which is not too great will have negligible effects on radiated power and SWR. However, if your antenna is cut for a harmonic frequency of 28,400 and you desire to operate it on a 29,600 ground wave net, better choose a dipole.

After a fundamental frequency has been chosen, refer to the chart for the overall length of the flat-top portion of the antenna.



Now, what makes this antenna off-center fed is the simple fact that a *single feed-line* (*not* 300 ohm ribbon) is connected to the flat-top a certain distance off center. Special emphasis should be given to the feed-line here as almost all hams which I have contacted question that. It *is* a single piece of #14 wire, just like the flat-top, of random length. It is soldered directly to the flat-top at the proper point. The other end of it goes directly to the output of the rig, or antenna coupler (preferably the latter, but the former works quite well with a pi-net output).

The distance off center is fairly critical, and close attention should be given to the accompanying chart showing this. Be sure the joint between the feed-line and flat-top is clean, and well soldered.

In erecting the antenna, the feed-line should come away at right angles to the flat-top for as great a distance as practical. It should not have any sharp bends in it, either.

Now, here's what makes this antenna such a dilly for high frequency DX work. It acts just like a long-wire on those frequencies. And anyone who has ever read anything on antenna fundamentals knows that the longer a long-wire is, the greater its gain and directivity. And the gain on a wire of this length on 10 meters is not to be sneezed at! Neither is its directivity! With a little care in erection, a whopping signal can be pin-pointed in a certain locality with one of these antennas.

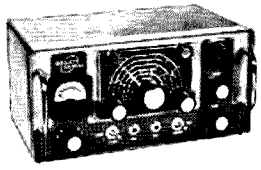
For exactly how much gain, and what sort of pattern to be expected, refer to the charts in the ARRL Antenna Handbook. Remember that an 80 meter antenna that is a half-wave at the fundamental frequency is a full-wave at 40 meters, two full wavelengths on 20, three and a half on 15, and no less than four wavelengths at 10 meters.

"Sounds great so far," I hear you say . . . "what about TVI . . . after all, the neighbors are real dogs when it comes to "Gunsmoke"." If they have a 21 mc *if* in the TV set, there's a simple solution . . . move. If not, there is little to worry about, *so long as you have a good ground!* Of course, this should apply to any transmitter, but to one which gets its whole theory from operating against ground, it's doubly important. I have had no trouble with my Windom by operating against a ground comprised of an 8′ rod driven into the ground a depth of 7′. A good ground is a necessity.

TVI suppression will be all the better, as well as loading problems, if a good coupler is used. If you don't have a good ground or a coupler then listen to this direct quote from

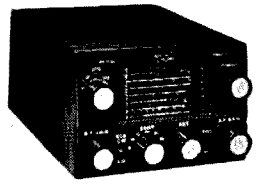
MULTI-ELMAC FIXED OR MOBILE

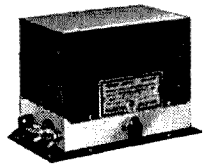
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6 thru 80 meters—VFO all bands—65 watts AM and CW.

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3 BLITZ-BUGS

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1. MODEL LAC-1 with one male and one female Type 83 connectors; install directly to equipment. **PRICE $3.95 NET**
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BLITZ-BUGS provide lightning protection for amateur, citizen-band, two-way and all other coaxial cable systems.
See Your Distributor or Write for Catalog

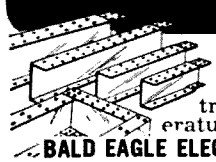
Cush Craft 621 Hayward Street Manchester, N. H.

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Change crystal frequency with this crystal etching kit. This popular SAFE WAY kit supplies everything needed (even for the plated type), ammonium bi-fluoride, containers, holders and complete instructions. Shipped postpaid for $1.00. De Lux model $2.00. Guaranteed.

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Preformed sections make chassis and boards easy to assemble **and wire!** Makes electronics fun. Write for **FREE** literature on new circuit technique.

BALD EAGLE ELECTRONICS DEPT. 2 LA CROSSE, WIS.

W8GZ: "I still hold the world's record for miles per watt using the antenna WITHOUT ANY GROUND WHATSOEVER on a battery operated 199 tube!"

Now a word or so about the recent trend toward modifying these antennas and using a 300 ohm TV ribbon feed-line. The Handbook says that many hams are doing this, claiming good results, but I think this is more fancy than fact. This is confirmed by the fact that the characteristic impedance of this antenna (using #12 or #14 wire) is 500 ohms at the feed point. Therefore, if balanced feed is desired, it should be effected through 450, or 500, ohm open wire feeders, *not* 300 ohm. The use of 300 ohm ribbon only adds to a mismatch.

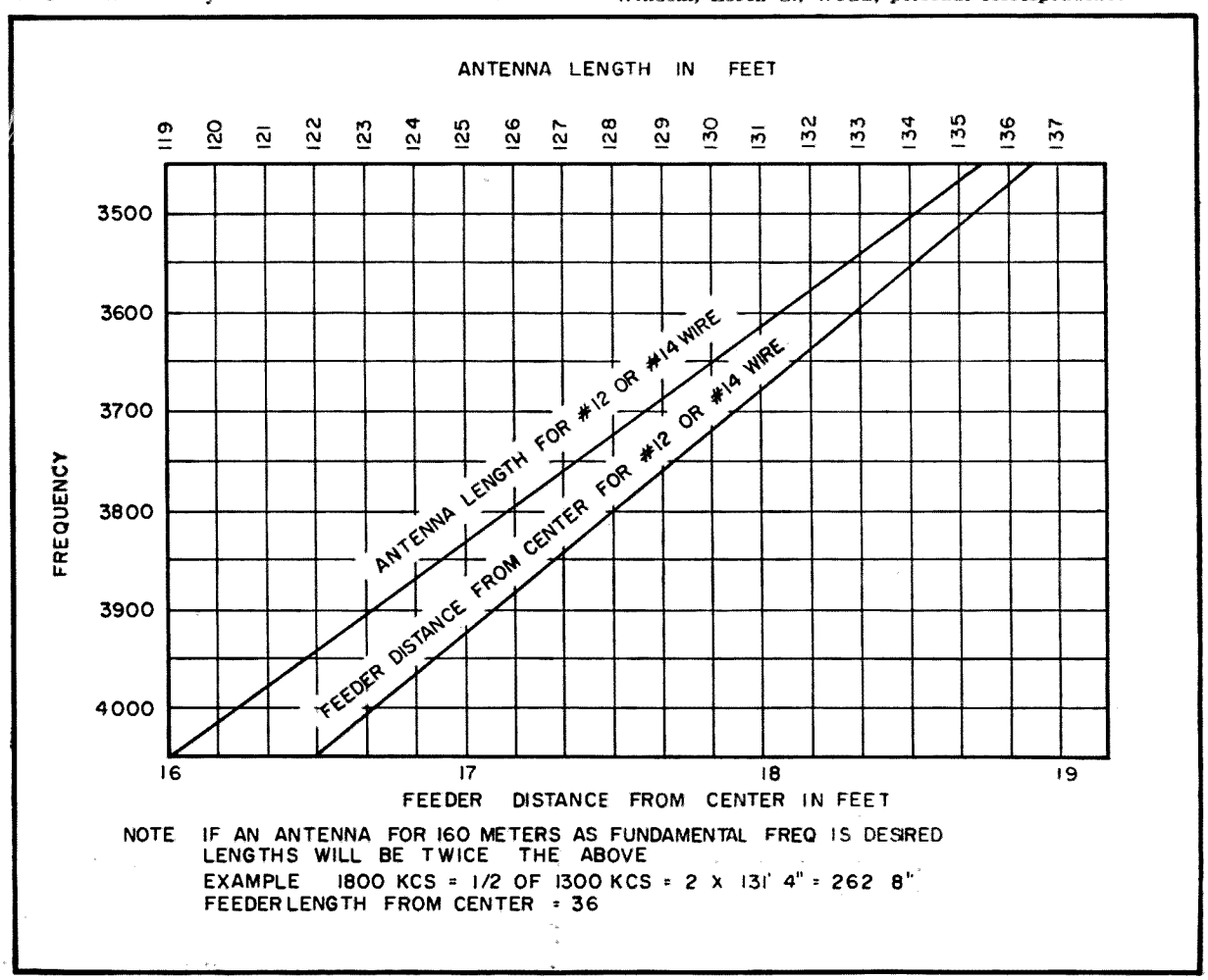
Finally, the question must always be asked, "Does it work?" Basing my opinion on my own results with it, I say most heartily that it does! Using 100 watts maximum input, phone operation only, I have worked into Hawaii, Puerto Rico and Canada on 40 meters with over S-9 reports. The latest hour of the night for any of these QSOs was 2300 EST. Many comments were received from Stateside hams who told me my 100 watts was "the loudest signal on the band." A series of tests was run with a ham in Maine over a period of several weeks with the Windom, again on 40 phone, and the weakest signal strength reported was five over S-9. But to top this all off was the fact that New Zealand on 40 phone was worked!

On the higher bands, over 70 countries have been worked using the Windom. All of this was on phone operation during the late summer of 1961 when band condition on 15 and 10 were not red hot.

The Windom deserves a place of recognition in today's antenna repertoire; it is inherently a sound antenna, using straightforward principles, and is very economical. Remember, should you put one up, that the overall length must depend on the fundamental and harmonic frequencies, that the feedline must be tapped in very carefully at the prescribed distance off center, and it should always be worked against a good ground.

Bibliography for Windom Antenna

ARRL, **The Antenna Handbook**, sixth edition
ARRL, **The Radio Amateur's Handbook**, 1961 edition
Philco, **High Frequency Radio Antenna Handbook**, Tech-Rep series, 1956 edition
Windom, Loren G., W8GZ, personal correspondence



The Whistler

Bill Leonard W2SKE

THE rig they are using on Deception Island these days uses 12 power transistors in parellel in the final running 1 KW input on 5 kc.

The antenna *is* Deception Island, a no-good location for anything but penquins, or a man trying to figure out how to work out on 5 kc.

One of these bitter winter nights a couple of British scientists will key that alternator, and hopeful folks like Professor Millett G. Morgan, W1HDA, and Wilbur C. Johnson, W1FGO, ten thousand miles away in Hanover, New Hampshire will listen for them.

For a receiver Morgan and Johnson can disconnect the family hi-fi set and replace the phono pickup with an antenna, a closed loop, 50 by 100 feet.

All the above is for real . . . simply the latest and most dramatic phase of their five year search for the Whistler!

A Whistler is not a character in a channel 2 TV series. It is an ultra low frequency *radio* emission—in the frequency range from 300-15,000 cycles . . . naturally created by an unknown source or sources, not necessarily by visible lightning as was believed for a long time. The Whistler is so called because it sounds like a warble, or whistle . . . the sound rolling down the musical scale from 10 kc to 1 kc in about one second.

Millett Morgan and his associates won't be generating whistlers—just signals of the same nature.

The story of Whistlers, now climaxing with the fantastic "Island Antenna" experiment, starts way back in 1880 in Austria when a scientist heard and made some notes about odd whistle-like noises coming out of telegraph lines. Curiously, the paper in which he described the phenomenon didn't come to the attention of the scientific world until 1955. Whistlers were first actually recorded by a Bell telephone scientist named Burton in 1931 and 1932.

About nine years ago Professor Morgan, attached to Dartmouth College's Thayer Engineering School, became interested in Whistlers, and while most electronic brains have been concentrating in the microwave world, he's lived with them. There's still an enormous amount we don't know about these strange VLF signals, but what we do know can be summed up about as follows:

They are generated by unknown sources (thunderstorms, lightning discharges seem to have *something* to do with it).

They travel with low attenuation along the lines of the earth's magnetic field and, in passing through the earth, move at speeds a lot slower than ordinary radio waves, only 10,000 instead of 186,000 miles per second.

They then keep right on going and penetrate the lower ionosphere, but are reflected back to earth at distances of 8-10,000 *miles*. . . a region where ionization is extremely low, perhaps 100 electrons per cubic centimeter.

In the northeast part of the U. S., the Whistler 'band' is 'open' most frequently between midnight and 3 AM local times.

Although Morgan and his associates recorded and analyzed 2700 kinds of whistler signals (some whistlers go swish, some go pop, and some make a sound like the fellows standing on the corner watching all the girls go by) it became obvious that a controllable emission would be most desirable if further knowledge was to be gained.

Morgan knew, of course, that there's no problem building a high power transmitter at 5 kc . . . the questions was how to radiate energy effectively at that frequency. Let's suppose you could build a half wave dipole (20

miles long), it would be, if suspended from a series of fifty foot telephone poles, the equivalent of a 20 meter antenna about a fifth of an inch off the ground! A vertical of practical height would be such a tiny fraction of a wave length as to do almost no radiating.

But Morgan remembered the slot antenna which is, in essence, the reverse of the ordinary dipole concept . . . i.e., by cutting a hole, or placing an insulator in the middle of a large conducting surface, radio waves will be effectively radiated from the hole, or slot. Slot dimensions are comparable to normal dipole dimensions.

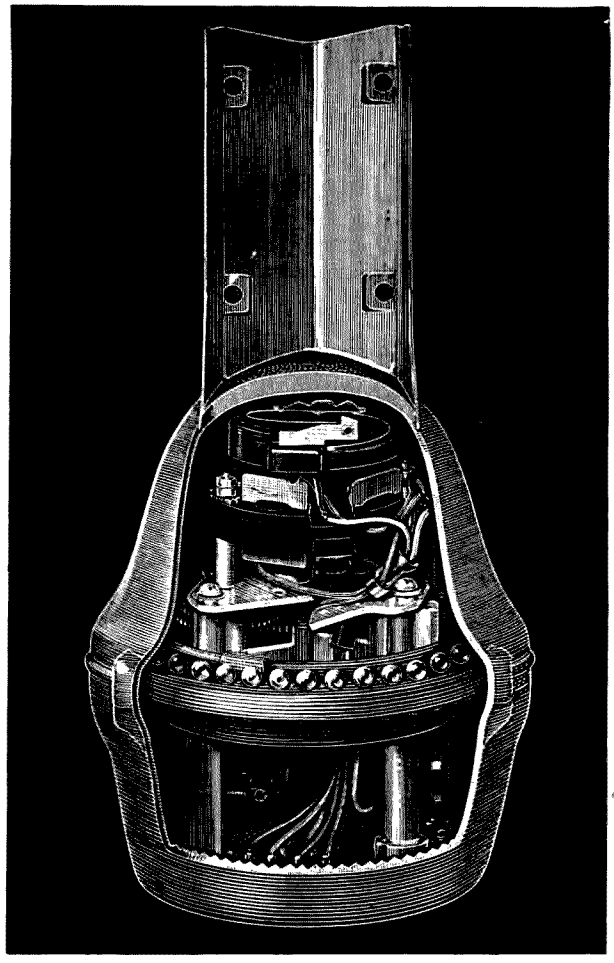
The men set about looking for a natural slot, in the area where Whistlers seem to eminate in great numbers, the South Atlantic. Scanning an atlas, they came across Deception Island, an extinct volcano, just above the Antarctic circle north of the Palmer Peninsula. The island is shaped like a horseshoe, and its total length makes it just about resonant on 5 kc. If it turned out that Deception Island actually would act as an insulator, so that currents generated near its edges actually flowed around the island, perhaps the 'skywire' problem could be solved by a 'seawire.'

Two British scientists set out a year ago laying cables—feeders if you will—in the Deception Island harbor. Wires were laid from the center of the ridge toward the sea in both directions. They were laid ten meters apart and there were ten wires, paralleled at the center. The ends of these were bared for 50 feet, a rock tied on, and the 50 feet flung into the water—one group into the sea outside the island, and the other group into the bay within the arms of the island. The wires were paralleled so that the impedance of the wires would not get into the act any more than necessary. When they measured the surge impedance, it turned out to be amazingly close to 52 ohms!

The British scientific team is now on Deception and soon expects to fire up the rig and poke a signal into receiving locations not only in Hanover, where Morgan and Johnson will be listening, but in a dozen other locations around the world.

Hams interested in trying to get in on some of this extraordinary Whistler DX—we don't know if Deception Island qualifies for separate country status—should contact W. C. Johnson, W1FGO, at Dartmouth College, Hanover, N. H.

The suggestion from this corner is that Morgan and Johnson work up a WOW! (Worked Our Whistler) Award. . . . W2SKE



DESIGNED FOR HALF-TON ANTENNAS

We've designed our HAM-M antenna rotors to support a dead weight of 1000 lbs. Your antenna probably weighs a small fraction of that, so see for yourself the kind of safety margin the HAM-M gives you!

But there's more! A positive electromechanical locking mechanism provides 3500 inch-pounds of resistance to the side thrust and whipping action of hurricane-force winds. And its bell-shaped, high tensile strength aluminum alloy housing is completely waterproof, assures brilliant performance even when caked with 5 inches of ice!

At $119.50 amateur net, the HAM-M is the greatest rotor value around! Ask your local CDE Radiart Distributor for all details.

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Jim Kyle K5JKX

Power Booster

Increase your rf power output by 35 percent

WOULD you like to increase the rf power output of your transmitter by 35 percent for less than $6?

If you're now using a rig in the 30-to-90 watt class, with either an 807 or a 6146 as the final amplifier tube, and operating in the 3-30 mc range, you can do this (or at least approach this performance increase) simply by rewiring the final-amplifier socket to accept a type 6DQ5.

Before you rush out to buy the bottle, though a word of caution—this trick works only for the low-frequency gang. The 6DQ5 will not operate at 50 mc and above, because of series resonances within the tube structure; any attempt to use it at these frequencies can result in serious damage to the transmitter.*

In case you're interested in how this "something for nothing" improvement in performance works, take a look at the characteristic curves of both the 6DQ5 and the 6146 (Fig. 1). The key lies in the locations of the "knees" of the curves.

*Yes, this is true, although certain models of Gonset equipment use the 6DQ5 at 50 mc. The tubes they use are specially made, Gonset informs us. Off-the-shelf tubes will not work above about 35 mc.

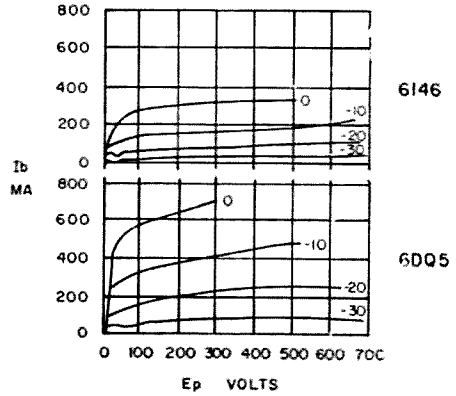


FIG. 1

Notice that the knees of the 6DQ5 curves lie more to the left than do the knees of the corresponding 6146 curves. This means that the 6DQ5 requires less plate voltage to deliver the same amount of current than does the 6146. With less plate voltage required by the tube, more voltage can appear in the output circuit (since the tube and the output circuit are in series, the supply voltage must be divided between them).

The resulting increase in efficiency is most noticeable at low plate voltages. If you're operating with a 750-volt power supply, you'll get only a 5- to 10-percent increase in power output. If your power supply is 400 volts, though, the rf output will climb by nearly 25 percent. With a 300-volt power supply (often used in mobile rigs), rf power output may nearly double for the same input power.

The 6DQ5 offers an added bonus, if your power supply can stand it. This tube is rated to handle 285 ma cathode current, in contrast to the 160 ma rating of the 6146. This means that a single 6DQ5 can offer performance comparable to a pair of 6146's or 807's. With a 750-volt supply, the single 6DQ5 can be loaded up to 160 ma, and of this 120 watts input power, 96 watts will appear in the output.

A comparison of characteristics between the 6DQ5 and the 6146 is given in Table I, for various input voltages and plate inputs. The "6DQ5 Increase" column represents percentage increase over 6146 power output, not increase in efficiency.

All this theory is very nice, you may ask, but how does it work in practice? To answer that question, an ancient Harvey-Wells TBS-50 Bandmaster was subjected to the acid test.

Using a 400-volt supply (the maximum recommended by Harvey-Wells), the original 807 would load to 125 ma. At this input, the output lit a 60-watt lamp bulb to a reddish-orange glow.

With the 6DQ5, the same intensity of glow in the lamp bulb could be obtained at about 80 ma of plate current. When the rig was loaded to 125 ma, the bulb's glow was almost normal (calculated power for this input is 39 watts). Loading was then increased to 200 ma. At this load, the power supply voltage dropped to 300. The bulb's glow increased slightly, but the increase was barely perceptible.

At the 125 ma loading, the rest of the rig operated normally. Modulation was comparable to the original 807; drive was adequate. The only difference noted was a stronger signal getting out of the antenna.

To install this bottle in your own rig, three circuit changes will be necessary; a fourth may be required, depending upon the rig.

The first and most obvious change is the rewiring of the socket. The pin connections for all three tubes are listed below:

	1	2	3	4	5	6	7	8
6DQ5	Grid	Fil	Cath	Scr	Grid	Cath	Fil	Scr
6146	Cath	Fil	Scr	Cath	Grid	Cath	Fil	Shell
807	Fil	Scr	Grid	Cath	Fil	——	——	——

The second change provides proper grid bias. The 6DQ5 requires approximately —70 volts on its grid, where the 6146 likes —45 volts. Since the 6DQ5 draws little grid current (more on this later), grid-leak bias is impractical. Battery bias is recommended. Lift the ground end of the existing grid resistor from ground and connect it as shown in Fig. 2. At any convenient location, install two 30-volt hearing-aid batteries connected in series to provide 60 volts. Ground the positive terminal, and connect the lead from the grid resistor to the negative terminal. This applies —60 volts fixed bias to the grid; current through the grid leak will supply the additional 10 volts needed.

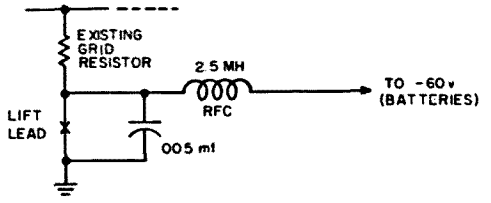


FIG. 2

The third change provides correct screen voltage. The 6DQ5 requires 150 volts on the screen, at 20 ma screen current. This is 8 ma more than the 6146 screen takes, although the voltage is the same, so the screen-dropping resistor will have to be changed. To determine the new value, subtract 150 from the plate-supply voltage, and divide the remainder by 0.02. Wattage rating of the new resistor, including a safety factor of two, is equal to 0.0008 times the resistance.

With many transmitters, this completes the modification. However, the output capacitance of the 6DQ5 is appreciably greater than that of the 6146 or 807, and as a result you may have to remove a few turns from the 10- and 15-meter tank coils to be able to tune through resonance. In addition, slight pruning of the coils may increase efficiency by getting a higher tank-circuit Q.

If your rig uses fixed tuning in the final grid circuit, re-peak the tuning slugs after making the modification. This is standard procedure whenever the final tube is changed, but the adjustment may be greater this time since input capacitance, too, is greater than that of the tubes replaced.

Don't expect grid current of the 6DQ5 to be so great as it was with the previous tube; the 6DQ5 is capable of delivering 175 ma of plate current without ever driving the grid positive, which means that no grid current at all need flow to be able to load the tube to its maximum ratings. The fixed bias added in conversion step two makes grid current unnecessary for tube protection.

The best way to determine the amount of drive needed with your rig is to hook up an output-power indicator of some sort (lamp bulb, wattmeter, etc.) and fire up. Start with maximum drive, and decrease the drive until output just begins to fall off. Now, increase the drive a hair. Check to see that power output increases with modulation. If not, increase the drive a bit more until upward modulation is obtained. This is the correct operating point for your rig.

So far, we've talked only about modification of existing equipment. Naturally, the 6DQ5 can also be used in new-design homebrew equipment. The no-grid-current feature eliminates the need for bulky drivers, since the oscillator itself may furnish enough voltage to drive the tube to its limit. Thus, high power becomes practical for mobile use—or for apartment dwellers.

. . . K5JKX

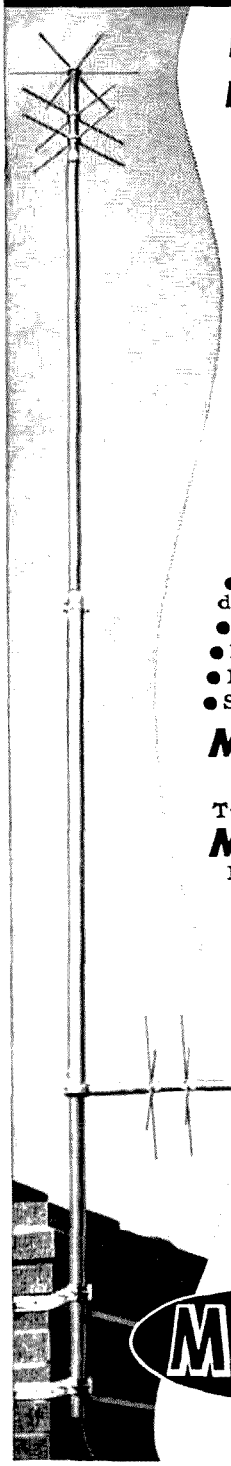
INPUT VOLTAGE, CURRENT, AND POWER			6146		6DQ5		6DQ5
Volts	MA	Watts	Output Power	Effi-ciency	Output Power	Effi-ciency	IN-CREASE
300	100	30	17	56%	23**	72%	35%
400	125	50	32	64%	39**	78%	22%
	185	74	Exceeds Tube Rating		57	77%	....
500	200	100	Exceeds Tube Rating		79	79%	....
600	112	67	48	72%	54**	81%	12.5%
	200	120	Exceeds Tube Rating		*95	79%	....
750	100	75	56	75%	60**	80%	7%
	120	90	*67	75%	72**	80%	8%
	160	120	Exceeds Tube Rating		*96**	80%	....

*Maximum Tube Ratings.
**No Grid Current Necessary.

Table I. Comparison of Characteristics, 6146 vs. 6DQ5

Another QUALITY MADE COMPACT ANTENNA

THE FIRST MULTIBAND COAXIAL ANTENNA for 6-10-15-20 Meters



needs no ground plane radials—

Ideal for . . .

Emergency nets and citizens band wherever omnidirectional coverage is desired.

Campers and apartment residents or *wherever* space is a problem.

A second antenna for low angle radiation.

The New C-4 features . . .

- Full electrical half waves on all bands . . . eliminating the need for awkward ground plane radials.
- Easy, inexpensive mounting with regular TV hardware such as simple chimney mount as shown.
- Compactness . . . only 12′ over-all height.
- End-loaded to provide maximum radiator current for maximum radiation.
- Quick installation . . . about ½ hour.
- Power rating . . . 300 watts AM.
- Feed line . . . RG58AU or equivalent.
- SWR . . . less than 1.5 to 1 at resonance.

Model C-4 amateur net **$34.95**

Two other 6-10-15-20 meter antennas:

Model B-24 Four Band Beam
Element length 11′ — boom length 5′
Turning radius 7′
amateur net **$54.95**

Model M-4 Four Band
Mobile • 5′-3″ high
Fits all standard mounts
amateur net **$16.95**

The above antennas are also available for 6-10 or citizens band operation.

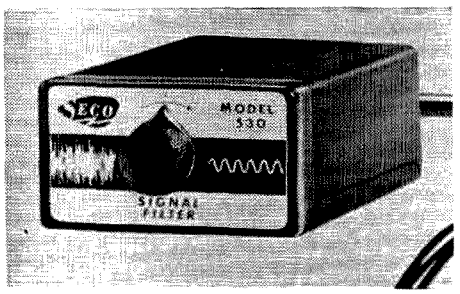
Write for literature and the name of your nearest Mini-Products distributor. Patents pending

Mini-Products, Inc.

1001 West 18th Street
Erie, Pennsylvania

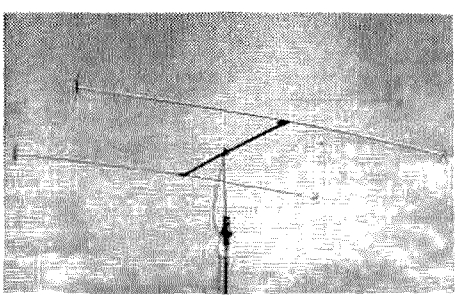
SPECIALISTS IN COMPACT ANTENNAS
Order direct or from your distributor

New Products



Mobile Noise Limiter

Seco Electronics has a small unit that connects to your mobile receiver and clips out the noise pulses generated by your own or passing cars ignition. The unit also has a controllable squelch built in. Quite a package for $16.88! Ask Seco about the Signal Filter, 1201 Clover Drive, Minneapolis 20, Minn.



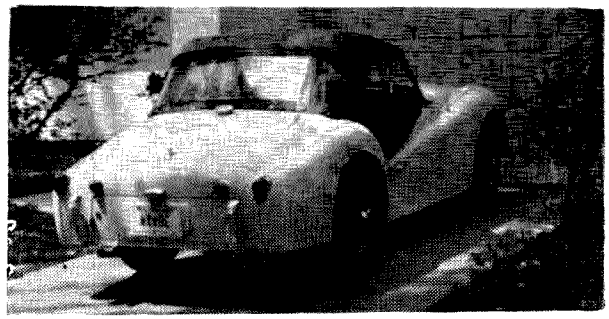
40 & 10 Meter Beam

Mini-Products hasn't been too busy filling orders for their 10, 15 and 20 meter beams to put in some time designing an answer to the dwindling sun-spot band condtions. Their answer is a miniature 40 meter beam which will also work on 10M. This $79.50 end-loaded beam will handle up to 1 KW on AM and is designed to operate with an SWR of less than 1.5:1 on 40M and less than 1.2:1 on 10M. Each element is only 20 feet long, which means that just about anyone can whip one of

these around. It feeds with a single 50 ohm feedline. You can drop Mini a card for mere details. Mention that you read about it in 73 . . . even if you didn't. 1001 W. 18th St., Erie, Penna.

In-Circuit Capacitor Tester

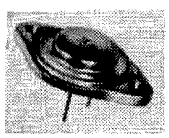
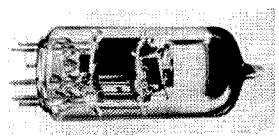
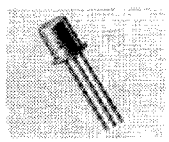
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The Drake TR-3

Bob Drake has a new sideband transceiver that will break shortly. It was first shown at the Dayton Hamvention in April and should be in production by fall. The new transceiver, designated the TR-3 (question: was this named after Bob's Triumph sports car or was it the next in line after the 1A, 2A and 2B? My bet is the car), covers all bands, 80 thru 10 and runs 150 watts PEP to two 6GJ5's. This sports car sized transceiver weighs only 12 pounds, not counting the power supplies.

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750ma	400piv	.59	.49
750ma	600piv	.89	.69
2amp	100piv	.59	.49
2amp	200piv	.79	.65
2amp	400piv	.99	.79
2amp	600piv	1.69	1.39
15amp	100piv	2.49	1.99
15amp	200piv	2.99	2.59
15amp	400piv	3.99	3.39
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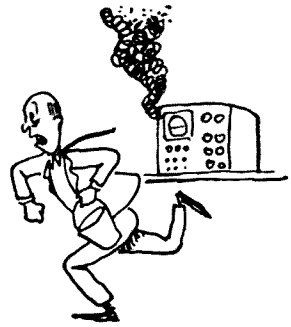




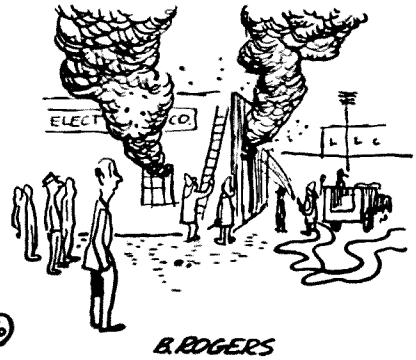
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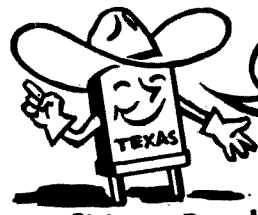
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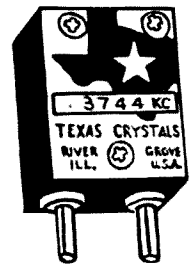
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THE most disheartening phrase heard on the air is "I built a ——, but I couldn't get the bugs out!"

The original model of a piece of commercial gear is usually a prime example of excellent engineering. The design engineer, knowing the pitfalls of interaction between stages, self-oscillation, parasitics, heat conduction, etc., carefully takes all these things into consideration in his original design. The unexpected bugs which arise during the building of the engineering model are also worked out and the final result is a stable piece of gear, capable of doing exactly what is expected of it and incapable of doing that which is not desired.

The job is now half done. The engineering model, in its present form, may be a pleasure to behold and operate but its cost of reproduction would be more than the average consumer would be willing to pay. The second half of the job is to find every possible shortcut, labor saving trick and money saving step that can be devised. How well this is accomplished will determine the company profit.

The first step is to reduce the number of parts in a piece of equipment to a minimum. Parts cost money to procure and more money to install. These extra costs must be borne by the buyer and serve to make the competitors product more attractive.

The first possibility in this parts saving campaign to fall under scrutiny are the "stability insurance" components such as extra by-pass capacitors, decoupling circuits and shield baffles. A systematic campaign is set in motion to remove as many as possible of these components or to employ a cheaper scheme to accomplish the same end. It is very true that the final production gear's operation suffers somewhat for this cutting and slashing, but only laboratory instruments can usually determine how much.

The final production line model, stripped of as many safeguards as possible, is a reasonably stable piece of gear capable of good performance under normal circumstances and may be expected to enjoy a reasonable life expectancy.

Engineers of commercial gear are a sly lot, usually of the grey hair variety and armed with years of experience. They know how far they can carry this austerity program before trouble sets in and that particular piece of equipment gets a bad reputation. Occasionally some model slips by that causes headaches from complaints from irate customers, but not often.

The Home Constructor

The home constructor works in reverse from the manufacturer. He begins with basic circuits picked at random and combines them into a multi-stage transmitter or receiver. Such things as extra by-pass capacitors, decoupling circuits, etc., are usually omitted from the basic circuit diagrams available to the home builder. He is also prone to simplify construction to the highest possible degree. If the Goode Electronics Company's PDQ-3 receiver doesn't have a decoupling network in the first *if* stage but does have one in the second, and the Goetter Beacon-6 receiver has one in the first but none in the second then you may rest assured that the receiver built by the home builder will copy the first *if* stage of the PDQ-3 and the second *if* stage of the Beacon-6. Our boy has no decoupling circuit in either stage. He is in trouble!

The home constructor who appreciates the original areas of difficulty in the design of commercial equipment and who does the first half of the engineers job faithfully will find that many of his difficulties will solve themselves. It is also much easier (and neater) to plan for and install vermin traps from the beginning than it is to try to squeeze them in somehow after the equipment is completed.

The manufacturer can afford to kick an engineering model around, tear it apart, rebuild

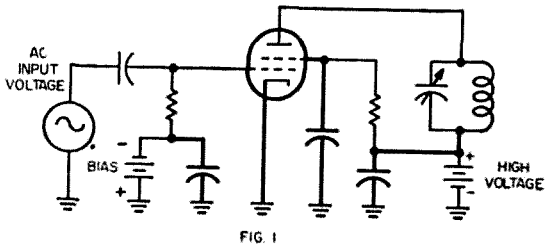


FIG. 1

it, and eventually find out how many short-cuts it can stand and still work. The home builder cannot afford such luxury. A few dollars wisely spent on de-bugging devices, whether they are actually needed or not, will prove the most economical course. Since the home builders project is a "one-of-a-kind" piece of gear it is pointless to engage in any form of simplification or austerity program after construction is completed.

The purpose of this article is to outline some common engineering problems and some of the solutions which should aid the constructor in designing his own equipment and keeping it housebroken.

By-passing

The by-pass capacitor's reason for existence is to do two things (1) Provide a completed ac path within the individual circuit of which it is a part, and (2) Prevent ac energy from escaping and traveling between circuits via dc or other ac paths not designed to transport it.

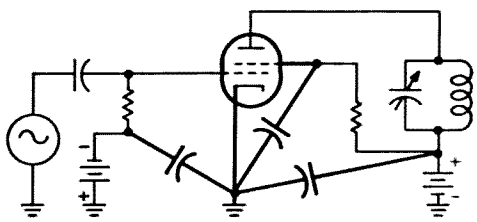


FIG. 2

Let's investigate the first reason for the by-pass capacitor; the completion of an ac path within an individual circuit.

Circuits for amateur gear using tubes (and transistors) fall into three basic categories: Grounded Cathode (Conventional), Grounded Grid, and Grounded Plate (Cathode Follower).

By-passing the Grounded Cathode Circuit

Grounded cathode are conventional amplifiers in which the signal to be amplified or the portion of the signal to be fed back to sustain oscillation is applied between the grid and the cathode. The amplified signal appears between the plate and cathode. The cathode is the common reference point and both the grid and plate circuits must have complete paths for ac to it. In the vast majority of cases, to simplify construction and the application of the necessary dc voltages, the cathode is operated at ac (signal) ground potential.

When ac ground potential coincides with dc ground potential by-pass capacitors installed to the dc ground or chassis (Fig. 1) will usually be adequate.

The main problem with this circuit lies in eliminating the return of ac from the grid and plate circuits through long paths through chassis material, which, surprising enough, at high frequencies, may present sufficient inductance to both circuits in common to permit exchange of energy from the plate to grid circuit and cause unwanted oscillation. The wisest course of action is to make the by-pass leads as short as possible and direct to the cathode ground connection as shown in Fig. 2.

Note that screen by-pass capacitors in the case of tetrodes or pentodes are also returned directly to the cathode.

Most pentode circuits require the supressor grids to be grounded direct to the cathode. In those cases where a suppressor grid voltage must be applied, the by-pass capacitor should be brought directly to the cathode in the same manner as the screen by-pass capacitor in Fig. 2.

The same rules apply for beam forming plates in beam power tubes.

Circuit configurations in which the cathode is not operated at dc ground potential, and ac and dc ground potential are not coincident, are more common than the ideal case given above. An excellent system as far as economy of dc power supplies is concerned is to use the static dc plate current flowing in the output circuit to provide a voltage drop through a resistor between the dc ground and the cathode. This voltage is determined by the size of the resistor and places the positive potential of the cathode (with respect to the zero dc potential of the grid) at the proper bias value for operation or for protective bias for an emergency should the normal biasing arrangement fail. This system, while economical in some respects, has the disadvantage of complicating the by-pass problems.

The usual circuit arrangement is shown in Fig. 3 (A). This arrangement is satisfactory

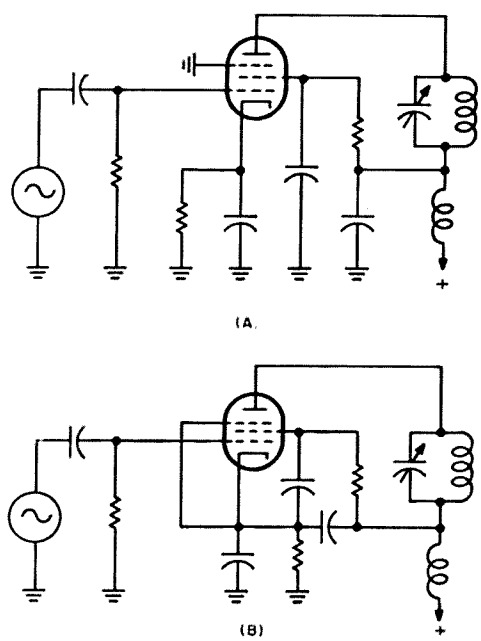


FIG 3

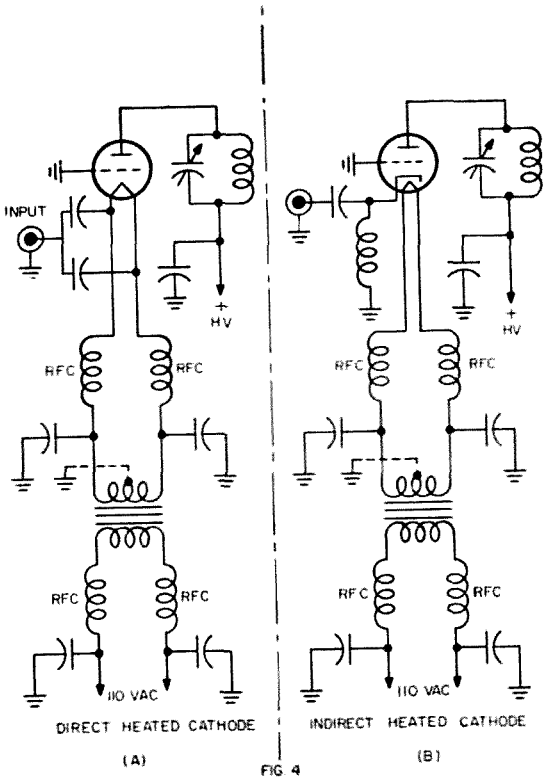


FIG. 4

for audio and lower frequency circuits but leaves much to be desired as the frequency of operation goes higher. A more stable by-pass arrangement is shown in Fig. 3 (B). Note that the plate by-pass, screen by-pass and the suppressor grid are tied directly to the cathode and any ac signal voltage appearing across the cathode resistor and by-pass capacitor does not alter the relationship between the screen, plate, or suppressor with respect to the cathode.

By-passing the Grounded Grid Circuit

Grounded grid are amplifiers in which the signal to be amplified, or the portion of the signal fed back to sustain oscillations, is applied between the cathode and the grid and the amplified signal appears between the plate and the grid. The grid is the common reference point. Both the cathode and the plate must have low impedance paths to the grid. Fortunately most grounded grid amplifiers operate with the grid at both ac and dc ground potential.

The grounded grid circuit is, as a rule, a well behaved amplifier. The insertion of parasitic chokes in the plate and grid leads are all that are normally required in the line of de-bugging procedures. Installation of by-pass capacitors to a point common with the chassis grounding point for the grid will usually cure any tendency toward instability.

It is recommended, however, that grounded grid amplifiers utilize separate filament supplies, isolated from the filament supplies of other stages of the same piece of equipment. A unique source of trouble in grounded grid amplifiers is feed-back of output energy through the filament circuit or transformer, eventually arriving into the 110V. ac supply line. This energy can cause trouble with TVI, BCI and instability in other stages of the same piece of equipment or adjacent equipment. For this reason the grounded grid filament supply should have isolation and by-pass circuits installed as shown in Fig. 4 (A) and (B).

By-passing the Grounded Plate Circuit

Grounded plate circuits or "cathode follower" amplifiers find considerable popularity as "isolation amplifiers" between oscillators and succeeding stages. Their use isolates the oscillator from load variations and contributes to stability.

In grounded plate amplifiers the input signal is applied between the grid and the plate and the amplified signal appears between the cathode and the plate. The plate is the common reference point and is usually at ground potential for ac. Seldom is the plate of such an amplifier at ground potential for dc. Consequently a coincident ac and dc ground reference point seldom exists. Fortunately this circuit is characterized by less than unity voltage gain and is consequently quite stable.

The application of cathode follower amplifiers is usually limited to low power transmitter and receiver stages. In these applications the by-pass arrangement shown in Fig. 5 will usually be adequate. If one side of the filament is grounded then only one by-pass capacitor is required from the "hot" filament lead to ground.

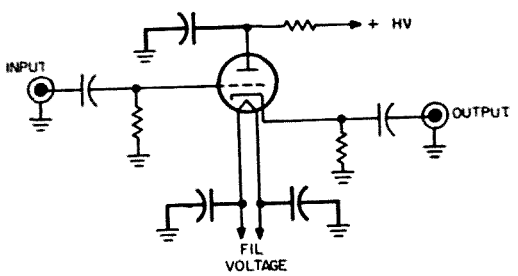


FIG. 5

If high power application is made of the cathode follower circuit (and a distinct possibility exists for such application) then the same precautions should be taken with the filament supplies as were taken with the grounded grid amplifiers.

Decoupling Networks

When installed properly the by-pass capacitor can accomplish its first task very adequately. The circuit, if isolated, behaves admirably and accomplishes its business in a stable and efficient manner. Unfortunately the circuit, of which the by-pass is a part, must usually work in conjunction with other circuits sharing the same plate and bias supplies.

The by-pass capacitor can, instead of accomplishing its second task of preventing output energy from escaping and traveling between circuits, actually assist in the unwanted transfer and loss of this energy. This is not quite as confusing as it sounds.

As an example of how this can come about, let's look at Fig. 6. In this diagram all screen grids and suppressor grids have been omitted for the sake of simplicity. Observe that the plate tank circuits of V_1 and V_2 have a common power source; and a ganged tuning capacitor with the rotors grounded and by-pass capacitors C_2 and C_4. There is nothing unusual about this circuit. The same configuration is used in dozens of different applications. C_2 and C_4 provide low impedance paths to complete resonant circuits C_1L_1 and C_3L_2. All looks very good and proper!

Don't believe it!

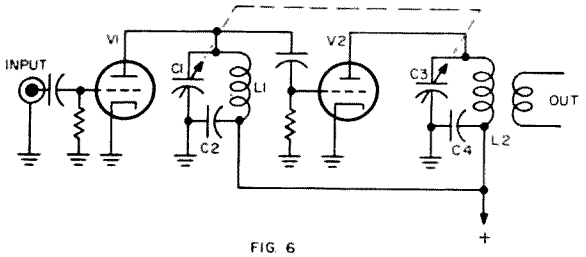


FIG 6

Suppose we substitute the internal impedance Z of the power source for the B+ to ground and simplify the circuit components we are interested in. We come up with an initial circuit similar to Fig. 7 (A).

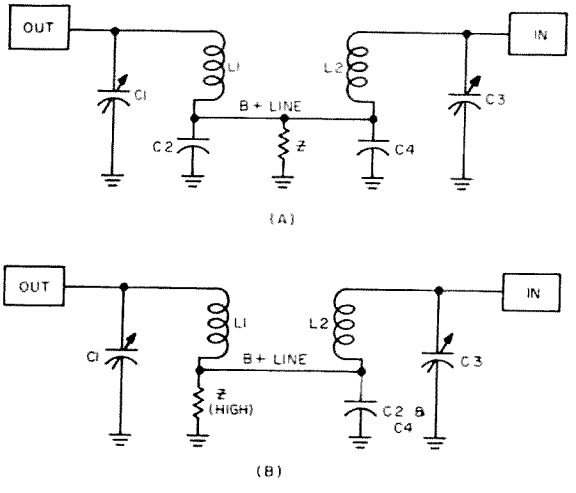


FIG 7

Z represents the impedance (to rf) of the power supply. Power supply filters may provide excellent characteristics at 60 or 120 cycle ripple frequencies but take on the form of considerable inductive and resistive reactance at rf frequencies. Z is actually much higher than simple mathematics would indicate and for practical application Z may be large enough to almost be ignored completely. The circuit under these circumstances approaches

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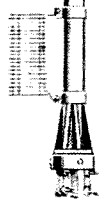
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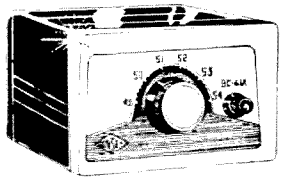
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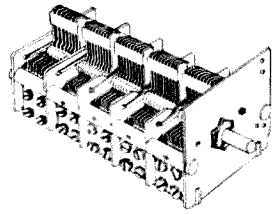
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that of Fig. 7 (B). L_1C_1 and L_2C_3 appear as two PI networks, back to back and connected by a transmission line of medium loss. As long as the losses of the transmission line are large enough all is well, but when these losses permit sufficient transfer of energy between the two circuits (and it takes very little) then instability results.

The B+ line shown in Fig. 7 (A) and (B) is only an example. An AVC line of a common bias source can be just as guilty. The vermin trap necessary for breaking up this neat little arrangement is a decoupling network.

Decoupling networks serve to increase the rf losses in the interconnecting transmission line until a point is reached where the exchange of energy from one stage to another becomes so small that instability from this exchange ceases to be a problem. This loss can best be inserted by using an arrangement in which the low impedance output of the PI networks feed into a high impedance (for rf) transmission system. Such a system is shown in Fig. 8.

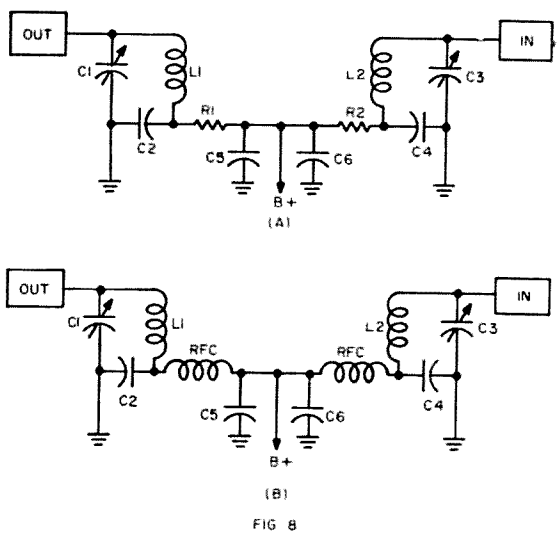


FIG 8

In choosing values for R_1 and R_2 in Fig. 8 (A) a rule of thumb which usually works satisfactorily is to permit about 10% of the dc supply voltage to drop across each resistor at normal operating plate current. As an example: If the L_1C_1 circuit is in the plate circuit of an amplifier requiring 10 ma from a 300 volt supply, a safe value for R_1 can be found by:

$$R_1 = \frac{30}{.10} = 3000 \text{ Ohms @ 1 Watt}$$

If the circuit L_2C_3 is in the plate circuit of an amplifier requiring 50 ma from the same 300 volt supply, then using the same rule and math R_2 would equal 600 Ohms @ 2.5 Watts.

Recommended values for C_5 and C_6 are C_5 equal to C_2 and C_6 equal to C_4, with C_2 and C_4 the usual values employed for the frequency of the circuits in use.

The above decoupling system, using an RC network, is satisfactory for low power applications or where the small loss in available voltage to the circuits will not tend to degrade the over all performance of the equipment or introduce problems due to the possible supply voltage fluctuations resulting from poor voltage regulation. In cases where a drop in voltage becomes a detrimental factor the more expensive decoupling network shown in Fig. 8 (B) is recommended. The rfc chokes chosen should provide an inductive reactance at the operating frequency of from 20 to 100 times the capacitive reactance of C_1 of C_3. Values for C_1, C_3, C_5 and C_6 will be the same as above.

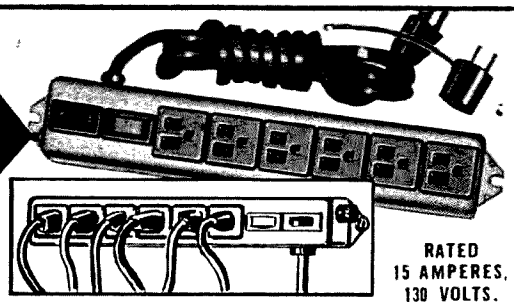
The insertion of only one leg of an RC or LC decoupling network will usually cure all but the most stubborn cases of intercoupling of this nature. As a rule, however, the same power supply is used to serve more than just two or three simple stages. In most cases it provides power for many varied stages operating on a multitude of different frequencies. The possibility of generation of birdies and other intermodulation products becomes very acute in such a case and decoupling networks are to be recommended for each and every stage. Plate leads are not the only leads needing decoupling—the AVC system, grid bias supplies and screen grid circuits should be given the treatment.

Shielding

The isolation between stages provided by bypass capacitors and decoupling networks assist greatly in taming complex gear but it can be compared to only putting bars on the big front doors. Unless the back doors and open windows are closed all the good accomplished by these safeguards may be lost.

Energy carried by electrostatic and electromagnetic fields may leak around carefully designed traps, jump across filters and detour around balanced circuits. These fields can cause birdies, images, back-wave, harmonics and instability. They can be the reason that balanced modulators refuse to balance and suppressed sidebands and carriers reappear. They can also cause oscillator pulling and intermodulation products.

The first step in keeping electrostatic and electromagnetic fields from lousing up the works is to avoid crowding. Unless a rigid space requirement exists which demands that a piece of equipment fit into one particular cubbyhole and no place else, a great deal of money and effort can be saved by employing standard panels, chassis, bottom plates, brackets and cabinets universally available. The present trend by manufacturers toward super-super compactness is commendable but hardly worth duplication by the home builder. If elbow room exists to build the equipment in the first place then sufficient room will usually exist to operate it when it is finished. The use of uncrowded construction will also permit

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some future modification and bug chasing without the underneath of the gear becoming too much of a brier patch.

Shielding can be designed to accomplish one or both of two functions. It can prevent the transfer of electrostatic and electromagnetic energy or it can serve as a baffle to reduce the transfer of heat. An ideally constructed piece of equipment would provide an electrically isolated container for each stage, maintained at a constant temperature well below the failure temperature of the weakest component. This is an order that is impossible to fill. The home builder should, however, shield until it hurts!

The ideal shield encloses the stage on all sides. It controls the energy entering to only one path from one source and the energy leaving to only one desired path. It also provides for the transfer of heat away from the stage as fast as it is produced and prevents heat from external sources from effecting the value of its enclosed components.

A practical shield will serve the purpose of controlling the transfer of energy to a low enough level to be practical. A practical shield need not completely enclose the stage or stages it is designed to serve. It must, however, prevent direct exposure to annoying fields and make the paths these fields must follow sufficiently long and complex to reduce their effects to something less than a critical level. Examples of practical shields are shown in Fig. 9 and Fig. 10.

In the design of such shields particular importance must be placed on their mechanical rigidity. A flimsy shield baffle, free to move or vibrate, can cause mechanical instability such as microphonics and frequency instability during temperature changes. More often than not these shield baffles are also used to support capacitors, switches, and other manual controls. Unless they are rigid they may contribute to backlash and frequency instability due to mechanical warping during operation.

Profuse use of shield cans for tuned circuits is recommended. In the use of shield cans, choose a size large enough so that the can shields the circuit without becoming a part of it. Cans smaller in diameter than three times the diameter of the enclosed coil form, or shorter than twice the length of its enclosed coil, add a distressing amount of capacitance to the circuit. Two small shield cans may also produce the same undesirable effects associated with flimsy shield baffles. The moral of the story?—Bottle 'em up tight but don't be stingy with the bottle!

I once made the mistake of mounting a 4E-27A next to the components of an ECO in the same transmitter. No electrical interaction was experienced, but as soon as the carrier was put on the air, and that blazing red 4E-27A began to pump out heat, the ECO took off across the band like a greyhound after a rabbit. In about one minutes time the signal had covered 15 Kc of the twenty meter band and was still going strong. A double shield baffle (Two pieces of aluminum with a quarter

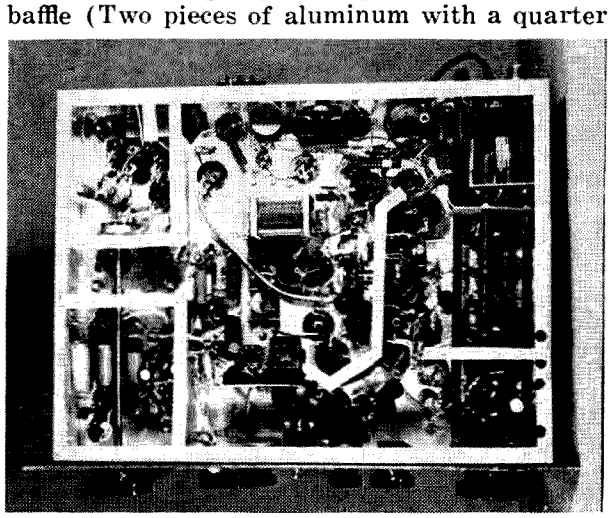


Fig. 9. Accented white lines show practical shield baffles installed in an SSB exciter to isolate frequency converter stages and succeeding amplifiers.

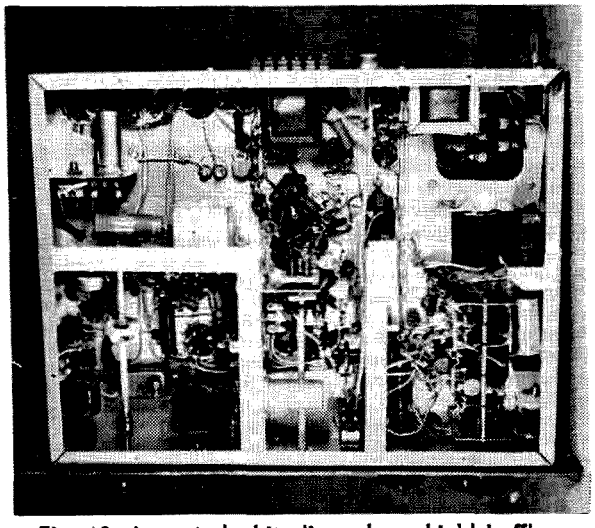


Fig. 10. Accented white lines show shield baffles installed in a triple conversion SSB receiver. Note the parts mounted on these shield baffles.

inch air space between) reduced the drift to about 5 kc per five minute transmission.—Quite respectable stability in those days! The installation of a blower to further remove more heat generated by the 4E-27A and temperature compensation of the oscillator would probably have reduced this drift much further.

Temperature Compensation

This brings us around to temperature compensation of oscillators. To work properly, the components of a temperature compensated oscillator circuit must be brought to operating temperature *slowly* and *evenly*. Any sudden heating (such as in the case mentioned above) will result in uneven heating of the various components and the oscillator will drift wildly both higher and lower in frequency as the various parts change temperature.

The presence of shield baffles assists the slow and even distribution of heat in four ways:

(1) By blocking direct radiation paths.
(2) By increasing the length of the path of movement of heat by conduction.
(3) By reducing the transfer of heat by convection. (Air-currents).
(4) By increasing the overall bulk of the material into which the heat may dissipate. This increase in bulk of material also helps in normal cooling since the larger the radiating surface of a body the faster it tends to lose heat to its surroundings. (This is also the principle of the heat sink).

Heat shields should be carefully designed to prevent overheating one portion of a circuit while protecting another. Ventilation of heat producing tubes and high current dropping resistors is particularly important to prevent overheating not only those components but also the entire piece of gear. Small phonograph motors of the type used in the RCA 45 rpm record changer are cheap and when fitted with a two or three inch homemade fan make a quiet blower which takes up little space. They also make no noise in the receiver. These blowers are satisfactory for use in gear where a little cooling seems the wisest option. Heavier blowers of course must be employed to cool components which normally require forced air cooling.

The mere movement of air within a shielded enclosure is not enough. Air should have a ready path through the equipment from an outside intake to another outside exhaust. When air is circulated a suitable dust filter to remove dust particles at the intake is almost a necessity. Dust particles, if not removed, have a tendency to accumulate a charge from high voltage components with which they come in contact and then to electrostatically adhere to neutral surfaces. This build up of dust can become severe in a surprisingly short period of time and may result in electrical deterioration and ultimate failure of the equipment.

Since air cannot pass through solid shielding baffles, some form of screening which will permit the passage of air but not of electrical energy becomes a necessity. A solid sheet of metal perforated with a multitude of very small holes is the most satisfactory solution to the ventilation problem. Screen material covering and carefully bonded to the edges of several relatively small ventilating holes is the next most effective solution and a screen covered single large hole is the least effective. In any case the amount of air that can be moved through such ventilating devices will be restricted to only about one third the flow that would pass through an unrestricted hole of the same size. The overall area dimensions of the ventilation openings must be made sufficiently large to compensate for this restriction. A word to the wise on this score—Don't forget that a one and three-quarters inch diameter hole will pass three times as much air as a one inch diameter hole. Multiplying the hole diameter by three is overdoing things a bit!

The subject of vermin traps for home made radio gear could go on for a thousand pages. Nothing has been said about parasitic oscillations, harmonic generation in transmitters, images in receivers, distortion, AC hum, or a score of other little beasties that plague radio equipment. The editor is a nice guy—but he has to have a few pages of this months issue for the advertisers. After all it is the advertisers that pay the bills!

This article should answer some of the questions on how to tame a home made piece of equipment—before it is even ready to plug into the wall socket. So shoulder your soldering iron, strap on your wire strippers and venture forth to smash dragon eggs. A smashed dragon egg never hatches into a full grown fire-breathing dragon!

. . . W2TBZ/4



The printed circuit board for this project is available from: Irving Electronics, P. O. Box 9222, San Antonio, Texas.

Don Wherry W6EUM
2121 Grandview Drive
Camarillo, California

Selectivity Number 1

THROUGH the past years the big problem which has constantly plagued amateur CW operators has been one of interference. This problem started years ago, during the hey-day of the spark outfits, reaching serious proportions at the peak of their activity. The advent of the tube transmitter alleviated the situation for a number of years but now again, with the thousands of new stations on the air, the poor CW operator is faced with a near intolerable situation.

During the past, receiver selectivity has been increased time and time again in an effort to keep pace with this interference problem and, in the case of the better receivers, has been partially successful. There are a number of receivers now on the market which have a bandwidth of 500 cycles at the 6 db point, however, these receivers are not cheap and for many of the ham fraternity are beyond reach. The cheaper models, meanwhile, are simply not able to handle the situation as it exists today. The little device to be described here is primarily for use with receivers in this latter category, however it is still able to improve the selectivity of the best of them.

A few words regarding receiver selectivity in general perhaps are in order here. As you know, "selectivity" is a function of the "Q" of a circuit and of the center frequency of its passband—when you measure the selectivity in cycles, not percentages. In other words a tuned circuit of a given "Q" will have a certain bandwidth at the 6 db point for one frequency and a very different one for another frequency —that with the bandwidth measured in cycles. As the bandwidth when measured in percentages stays approximately the same it follows that the lower the frequency the narrower the bandwidth in cycles. This shows why the low *if* frequency of 50 kc is used in the narrow bandpass *if* strips. The frequency of 50 kc is not the lowest which could be used and if a lower one were used a narrower bandpass would result, however other factors then enter the picture which make 50 kc the lowest practical frequency to use. Of course the bandpass could be narrowed to less than 500 cycles even at 50 kc by the use of better, or additional, filters but as the Q of the circuit is increased the problem of "ringing" presents itself and this also places a practical limit to the narrowness of the bandpass.

Of course there are other methods of obtaining high selectivity in *if* amplifiers such as the mechanical filter of the Collins equipment, but normally it is obtained by the used of high Q tuned circuits at a relatively low *if* frequency.

Now since we have decided that lowering the resonant frequency will result in a narrower bandpass while using the same Q, and with the same amount of ringing, we should be able to use a filter at some audio frequency and

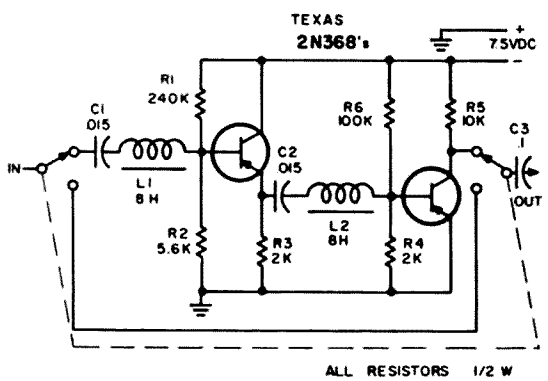
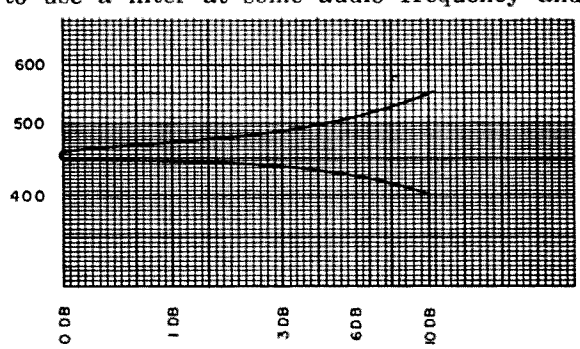
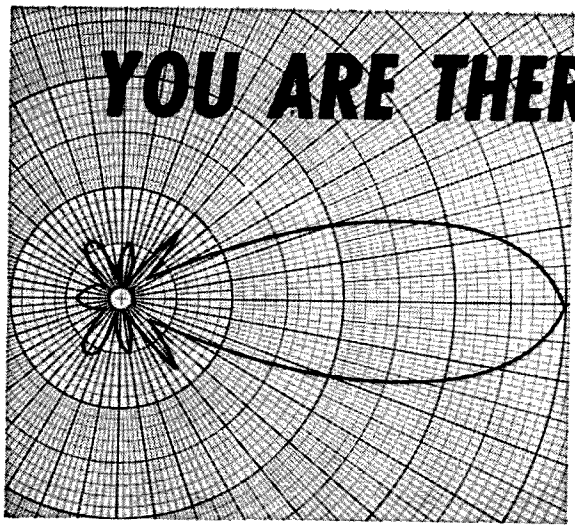


FIG. 1





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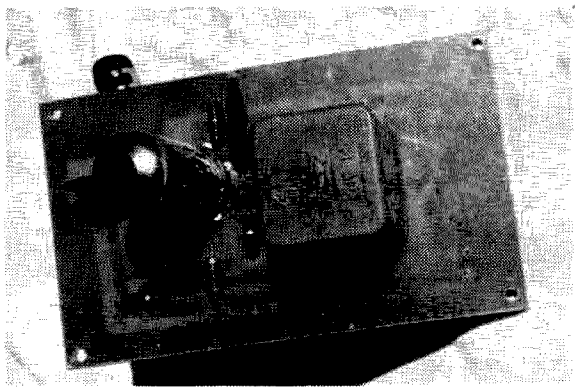
increase the usable selectivity and still circumvent these objections of a narrower bandpass at 50 kc.

The unit shown in the photo is such a device. It uses an audio filter which is peaked at 460 cycles and has a bandwidth of 105 cycles at the 6 db point. Please note that 105 cycles is a very narrow bandpass—nearly 5 times as narrow as the usual run of big receivers. Fig. 2 shows the bandpass curve.

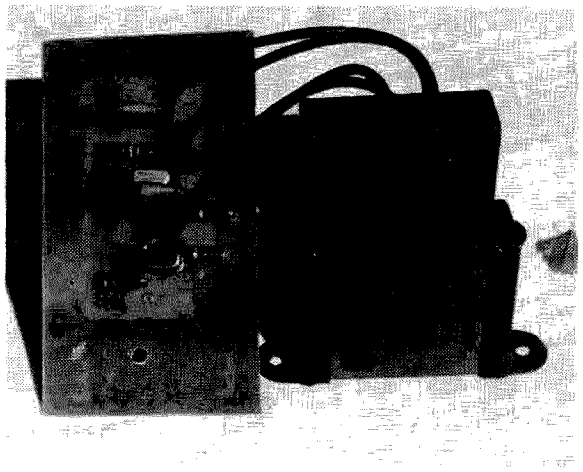
The schematic diagram (Fig. 1) shows the unit to be a two stage transistorized amplifier using a series tuned resonant circuit in the input of each stage. Transistors, with their low input impedances are particularly well adapted to the use of such input circuits. The first stage uses a Texas Instrument transistor, type 2N368 in a common collector circuit. This is, of course, similar to a cathode follower stage using a vacuum tube, and as such has a gain of less than one. A gain in this stage is not needed however, and such a circuit lends itself admirably to the task of driving the following amplifier stage. The tuned circuit in the input of this first common collector stage consists of a 0.015 microfarad condenser in series with an eight henry filter choke. You will note that this choke (L1) is called out as an ordinary 8 henry filter choke of the garden variety. This may sound strange to the audio man and should be explained. First; a high quality audio reactor such as the UTC VIC type could be used with an increase in selectivity (narrower passband) but in this case an improvement over the filter choke is not needed and, second, the difference in cost between such an audio reactor and an ordinary 8 henry choke amounts to several dollars. This does not mean you can not use a VIC reactor—you can and it would be very good.

The output of the first stage is taken from the emitter connection where it is fed through another series resonant filter identical to the one in the first stage and from there to the base connection of the second stage transistor. This second stage, which also uses a 2N368, is a common emitter circuit which gives the unit the necessary gain.

The center frequency of 460 cycles was arbitrarily chosen for the filter. A lower frequency could be used with its increase in selectivity by using larger condensers for C1 and C2 or, conversly a higher center frequency by using smaller condensers. If a high quality audio reactor (choke) is used, such as the VIC type, a higher center frequency could be used with the same bandwidth resulting. The



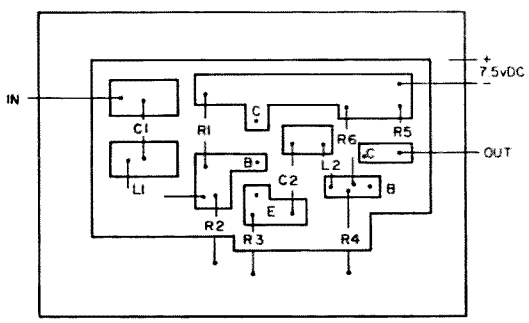
one thing to remember when choosing the center frequency to use, is that you are accustomed to hearing a lot of fairly high frequency background hiss, static, etc. when you listen to the amateur bands, but when you narrow the passband down to 100 cycles and center it below 500 cycles this is all gone and you get the feeling that you are down in the bottom of a well. This is no real problem however and after you listen to hissless, crackless sig-



nals for awhile you won't notice it.

As it will not always be necessary or desirable to have this device in the circuit it is switched in and out by the use of a double pole double throw toggle switch which, when in the "out" position, disconnects the unit from the circuit and connects the output jack directly to the receiver output.

There is nothing special about the circuit—as shown, the unit is constructed on a printed circuit board which, once you use one, you will probably use for everything. There have been several articles printed on how to use this material but just a few words probably would not be amiss. The circuit is laid out on a piece



C - COLLECTOR
B - BASE
E - EMITTER

FIG. 3

of paper—roughly at first—and carefully after the general layout is decided. The final drawing, on which all the resistors, condensers etc. will fit is then traced on the copper of the circuit board by the use of carbon paper. The copper to be left is then painted, using a very small pointed artists brush, and any kind of enamel or paint you might have on hand. The non-painted copper is then etched away, the paint removed, and you're in business. Any kind of a glass dish or pan can be used to hold the acid while you etch. The board and etchant can be purchased quite reasonably from several radio stores. Fig. 3 is the board used in this unit, drawn to scale so you may, if you wish, copy it directly from the magazine.

The Texas Instrument transistors used are general purpose types costing approximately $1.70 each at radio stores. Other similar types could probably be substituted with little or no difficulty. The board layout shown in Fig. 3 is drawn so that C1 and C2 may be two capacities in parallel instead of the one as shown if such are needed to peak both filters to the 460 cycle center frequency. If two identical filter chokes are used this peaking should not be necessary however. Also, sometimes 0.015 ceramics are hard to find so in that case two condensers in parallel can be used.

The unit is mounted in a box 3 by 4 by 5 inches with the audio input and output in the rear—this can be changed to the front if desired, of course.

This little device is truly a "bomb." Just try tuning in a CW signal to a beat of 460 cycles with some bad interference at say 1,000 cycles and flip the unit into the circuit. You will be very surprised at the way the interference, static, background noise etc. drops down and the signal you want jumps out at you. It will many times allow perfect copy to be made of a signal normally unreadable from the receiver output. It won't turn your $76 kit into a 75A4, but it will come a lot closer than anything I know of for the few bucks spent.

The unit uses a 7½ volt battery for power and, since it draws only 0.7 milliamperes, the battery will last for months. The on-off switch, not shown on the schematic (Fig. 1) is a single-pole single-throw toggle switch in the battery lead.

Just in case you are one of those who prefer vacuum tubes this device can be constructed using a 12AU7 as shown in Fig. 5. Everything previously said will also apply to this tube unit. In this case, however, a UTC audio reactor type VIC-14 was used instead of the filter choke and it gives a slightly narrower passband that the transistor model. The curve is shaped like Fig. 2 but is only 45 cycles wide at the 3 db point, 75 cycles at the 6 db and

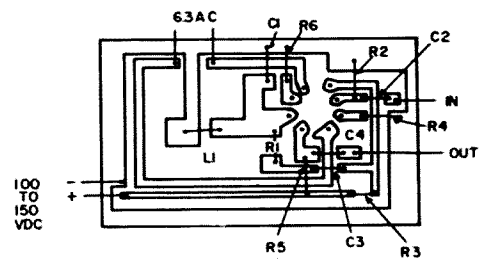


FIG. 4

125 cycles at the 10 db points. The overall gain is approximately 3 when using a 12AU7, which is sufficient. However if you would like more gain than that you may substitute a 12AY7 or a 12AT7 for the 12AU7 which will do the trick with no circuit changes. The printed board for this model is shown in Fig. 4 and is also drawn to scale.

While the two filter systems for the two models perform the same function, they do so in somewhat different ways. The series resonant filter of the transistorized model takes advantage of the fact that a transistor is a

low impedance input device and must be fed from a low impedance source. The impedance of a series resonant circuit is very low at resonance, amounting to the ohmic resistance of the reactor plus the losses etc. so this imposes very little resistance in the coupling between the two stages and also in the input of the first stage. As the input frequency is varied from this resonant point the reactance of the series circuit goes up rapidly, very quickly putting a high resistance in the coupling circuit which "decouples" the stages and cuts the gain. These series resonant filters are, in effect, a frequency conscious volume control.

The filter in the tube version acts on a different principle. In this model the characteristics of a parallel tuned circuit are utilized which are directly the opposite to those of a series tuned circuit. The reactance of a parallel circuit is very high at resonance decreasing rapidly as the input frequency is moved away from that point. By placing such a filter from

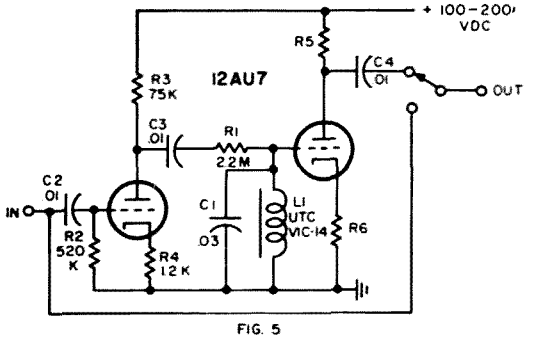


FIG. 5

the grid of the tube to the ground it can be seen that at resonance the grid is above ground, signal wise, and as the frequency is varied off resonance the grid rapidly approaches ground value. The 2.2 megohm resistor in series with the grid and filter furnishes a place for the signal to "drop" across when the frequency is off resonance and the filter shows a low reactance. The resistor then in effect "decouples" the stages when the input frequency is off resonance. This is a "losser" method of getting the desired result but as a gain is not needed this is of no matter. The 2.2 megohm resistor can be reduced in value and recoupe some of the lost gain if such is desired but if reduced too far some decrease in selectivity will result. Probably one megohm should be the minimum value. It is better to use the 2.2 megohm value and go to a higher gain tube such as a 12AT7 as mentioned earlier.

These two units will improve the capabilities of any receiver, regardless of the cost and when used with the $100 variety makes the difference between no copy and a solid copy in a large percentage of cases of QRM. But even if you do have an expensive receiver and do have a minimum of trouble with interference this unit is small and cheap to build (either model) so throw one together—it just might save that rare DX contact that you have been working on. ... W6EUM



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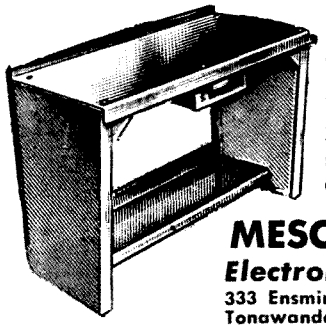


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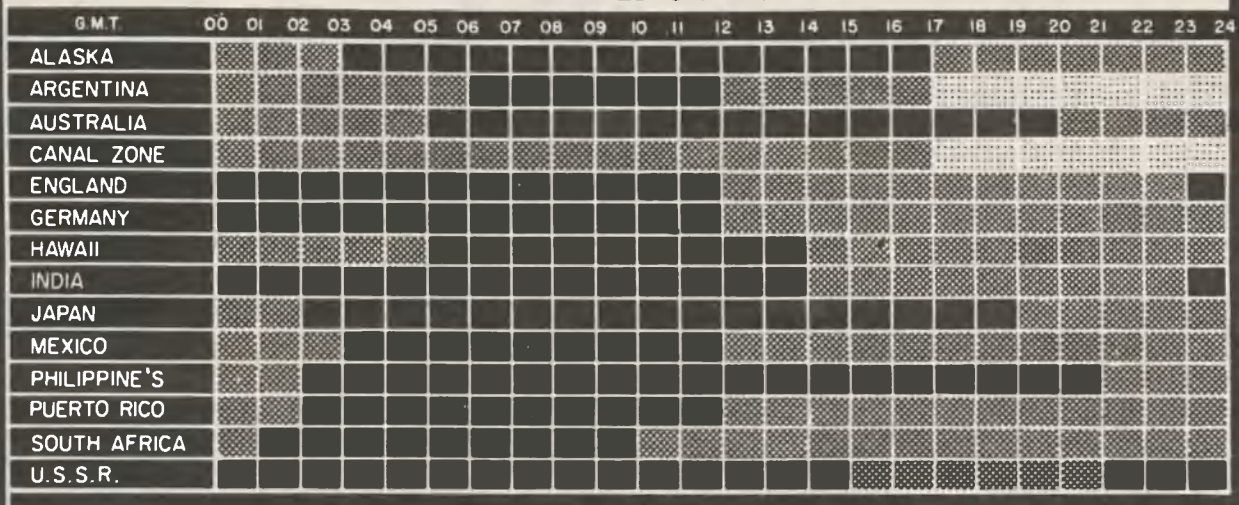
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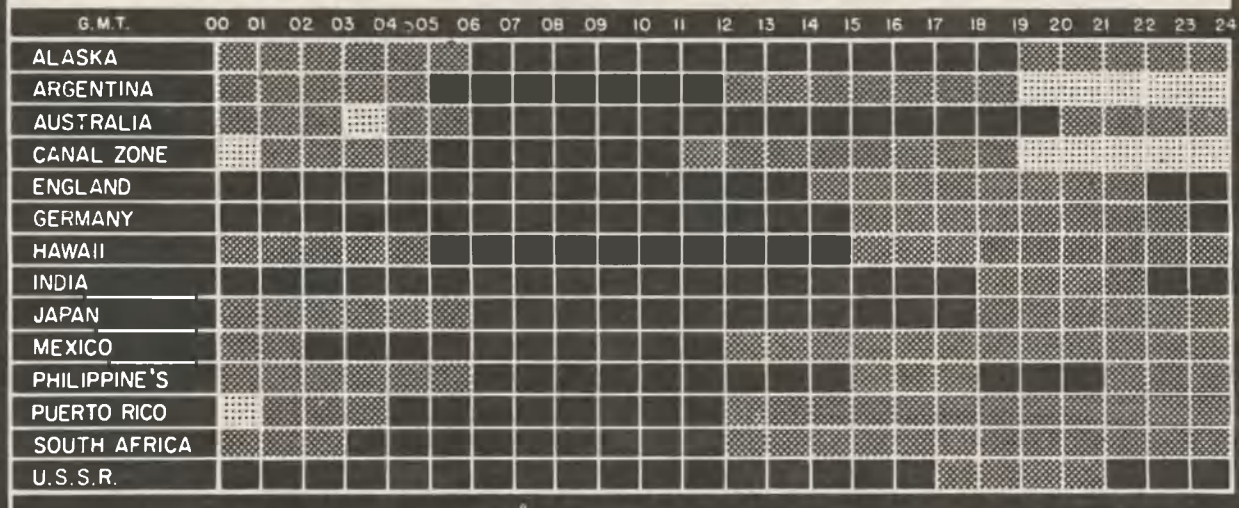
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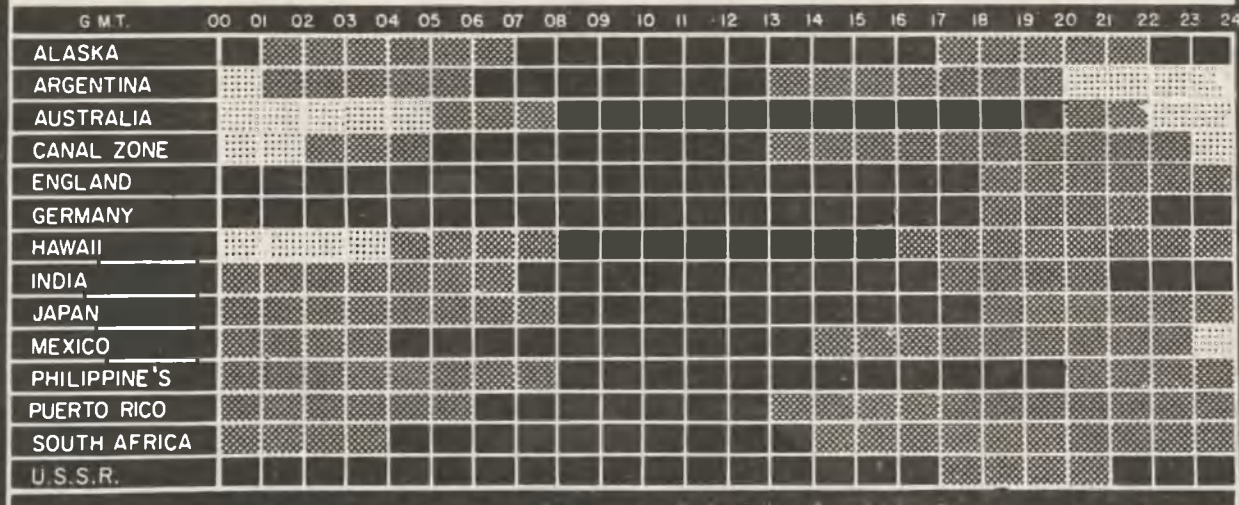
EASTERN UNITED STATES TO



CENTRAL UNITED STATES TO



WESTERN UNITED STATES TO



Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

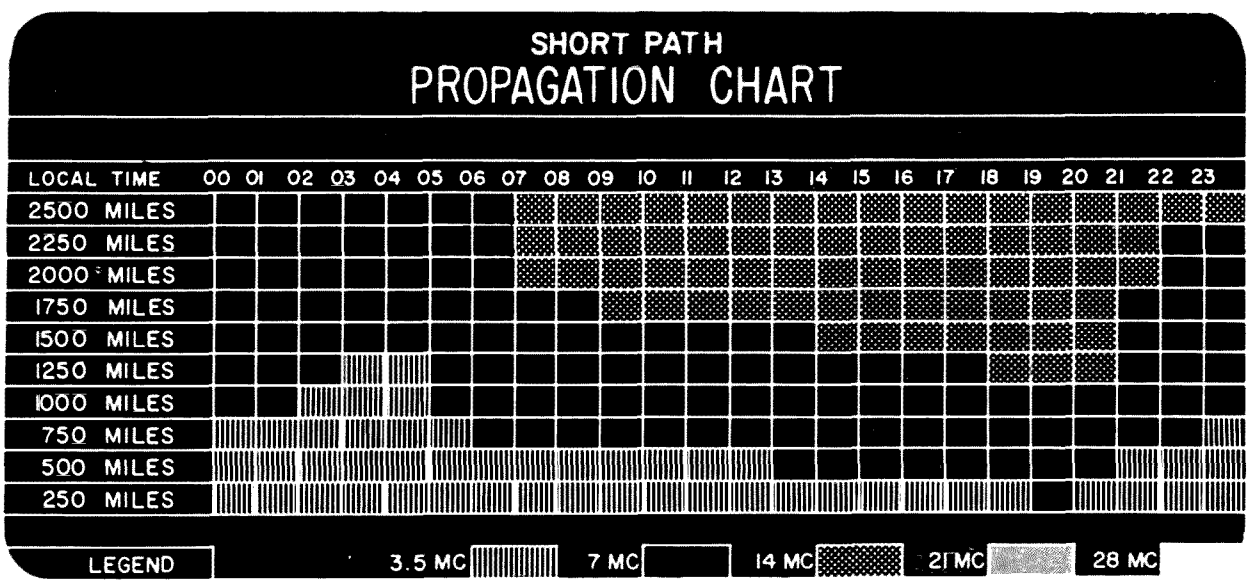
The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

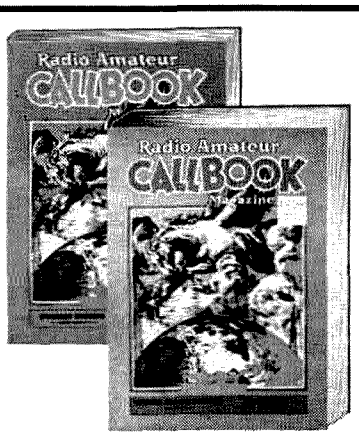
Advance Forecast: July 1962

Good: 3-13, 21-26

Fair: 1-2, 14, 16-20, 27-29

Bad: 15, 30-31





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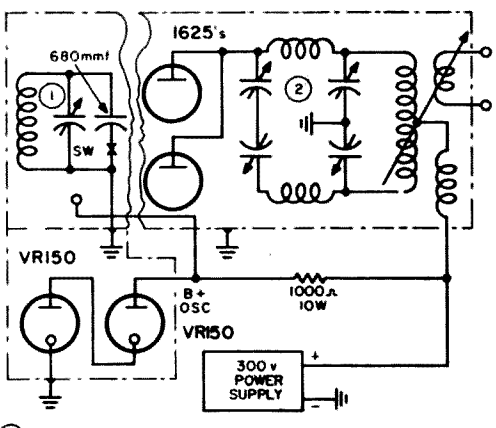
Old Friend in a New Suit

Arc-5 Exciter

Bob Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

I have always been too proud or too Scotch to purchase a store bought transmitter or even a store bought exciter. Likewise I have hesitated to buy the necessary parts to build a sure 'nuf all band home brew job. Consequently I have limped along for years with a one-band rig or a GF-11 with the coils rewound to work on 20 or 15 meters, the latter not being any too stable at times. It has always seemed to me that there ought to be a simple, "cheap and dirty," way to solve this problem. I think I have stumbled on to it.

The stability of the ARC-5 "command transmitter" is well known. More of them have been cannibalized in one way or another than any piece of surplus gear to come out of World War II. They are still for sale in every magazine you pick up. The only trouble is that, without extensive revision, they are good for only one band or two at most. If you start on 80 meters you need multipliers after you get below 40; in fact, it's difficult to cover both 80 and 40 with one coil. The advent of National all band tuners at bargain prices caught my attention; so I bought a couple of the small size and one of the larger size. The small one made possible about the simplest revision of the ARC-5 yet devised. All you need to do is take out the roller coil and the final plate coil and set the All Band Tuner in its place. Leave the tubes in parallel as they were originally and connect the tuner as per diagram by National. See Fig. 1. Use the existing rf choke and add a .002 mica by-pass from ganged condenser shaft to ground. You are now in business.

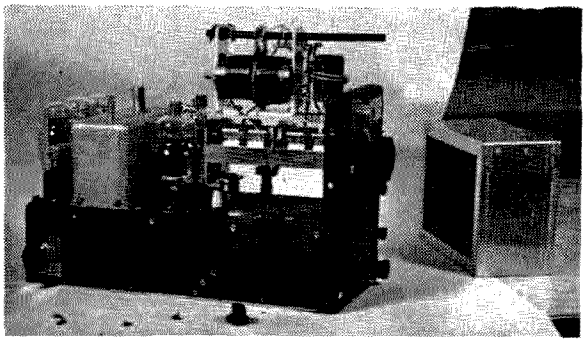


① OSCILLATOR GRID CIRCUIT ADD PADDER AND SWITCH FOR 80 METERS.
② NATIONAL - ALL BAND TUNER. MB-40 DL

FIG. 1

Well almost in business, that is. I chose the 7 to 9 mc unit for two reasons. First of all I had one on the shelf that had already had the crystal and eye tubes removed and replaced by VR tubes, affording a 255 volt regulated voltage for the oscillator. Secondly it looked like a natural to cover 40, 20, 15 and 10 meters. Such proved to be the case. Using a 300 volt supply (also found on the shelf) I obtained adequate output from 40 to 10 meters to drive something the size of a 6146 or 807. 40 and 20 meters provided sufficient power to drive an amplifier requiring a couple of watts drive. All you have to do is turn the dial on the tuner! Switching in a 680 mmfd silver mica padder in parallel with the grid tuning condenser makes it possible to also cover a 200 kc portion of the 80 meter band with a watt or two of output. A 1000 ohm 10 watt resistor was placed in series with the 300 volts and the oscillator-VR tube combination, the VR tubes already being on the rear deck of the ARC-5. 300 volts was fed directly to the 1625 stage, which is also connected to the series screen dropping resistor as well as the plate circuit.

If you're considering driving something on the order of a 6146 you can stop right here. I was planning on driving a 200 watt final that required a little more drive than could be obtained on 10 meters; and even 15 was a bit short. So it was decided to investigate the ARC-5 a bit farther. Removing the shield can from the oscillator reveals an air padder in parallel with the main tuning capacitor in the oscillator. If you disconnect this padder you will find that the oscillator fundamental frequency can go as high as 14.5 mc and somewhere in the middle it tunes to 10.6 mc. Surprisingly the stability is about as good as before. And now by doubling in the 1625 stage you can get either 15 or 10 meters with lots of output. So the final circuit used in the oscillator as seen in Fig. 2. incorporates a three position two gang rotary switch. Position #1 puts the silver mica padder in parallel with the main tuning and places the oscillator and hence the 1625 stage on 80 meters; in all other positions the silver mica is out of the circuit. Position #2: Oscillator circuit is the same as the original and the 1625 stage operates on either 40 or 20 meters. Position #3: the padder under the shield is disconnected and by tuning to the proper dial setting the oscillator is either on 10.6 mc or 14 mc and the 1625



stage gives full output on either 15 or 10 meters.

Due to the size of the all band tuner the cabinet of the ARC-5 had to be slightly modified. As can be seen from the photo, it was necessary to put a "top hat" on top of the original can. A little work with the tin snips was required to clear the tuner and a 5 x 6 x 3 inverted aluminum chassis was added. The only other mechanical change, aside from mounting the above mentioned rotary switch, was pulling a couple stator plates out of the old padder capacitor in the 1625 stage. This

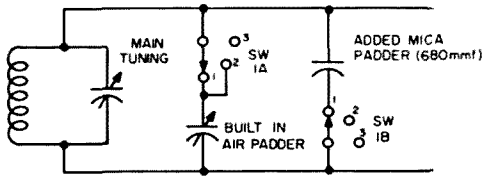
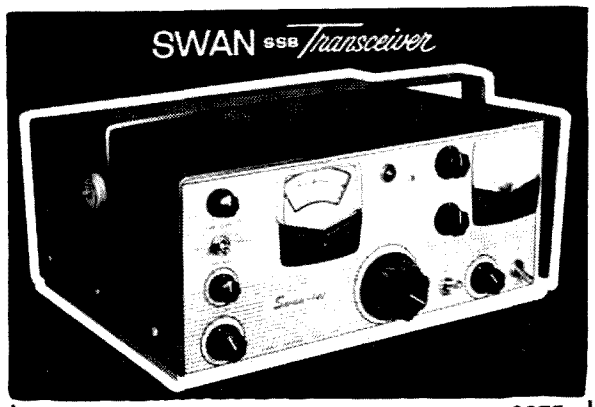


FIG 2

was necessary to get screw driver clearance for mounting the all band tuner. The holes came thru the base of this old padder. In my case this capacitor is no longer in use although it could be used, as well as the old 1625 main tuning capacitor, for part of the padder to get to 80 meters. In any event the removal of a couple of stator plates would not seriously harm the operation.

So, for well under $10 in addition to the ARC-5 you have a five band tuner! To those who have a 40 meter ARC-5 or command transmitter on the shelf and no all band exciter in the shack, this bit of refurbishing should be of interest. ... W7CSD



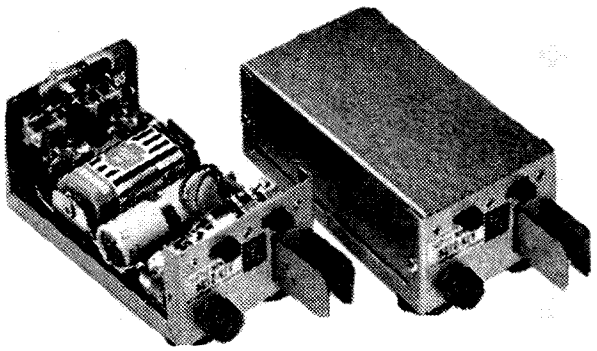
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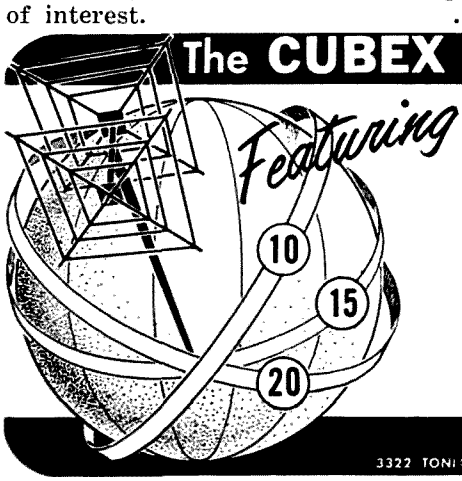
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Dear

Keeping the Indians

HAVE you recently moved to a new neighborhood? Are you planning to make such a move in the near future? Are you getting ready to put a new rig on the air? Has your rig recently become a bulging teepee for a tribe of Tennessee Valley Indians? Does your neighbor's TV set have a "wide-open" front end or a 21-Mc i-f? If you can answer "yes," or even "maybe," to any of these questions, this article may be just what the doctor ordered to keep tempers cooled until you can bury the TVI hatchet.

One of the most important ingredients in a TVI stew is good public relations. Yet, too often overlooked, but just as important as your neighbor being a jolly good (until now) fellow, is his understanding of the basic problem. If he doesn't have the faintest idea about the causes and cures of TVI, he can easily turn into an awful stinker, more out of sheer ignorance than impatience. This article has been prepared for the layman, in his own language, so that through his understanding the sometimes rocky road to a TVI cure can be more comfortable for both you and your neighbor.

Dear Friend,

You have an interesting neighbor with a fascinating hobby! He is a member of a worldwide fraternity of over a quarter-million inquisitive men, women, and children, in several hundred countries, who thrive on the never-ending magic of electronics and the adventure of interchanging ideas across oceans and continents at the speed of light. The farthest corners of the world are at his fingertips; just the flick of a dial will take him into the home of another amateur, perhaps thousands of miles away.

But the very mysteries of electronics which make this hobby so fascinating can bring something less than ecstasy to people who live near an amateur station, even to you. No amateur wants this to happen, and most go to fantastic efforts to make sure, as well as they can, that it doesn't. As embarrassing as the rare cases of interference are to amateurs, they can be downright frustrating to someone who is not familiar with their causes and cures. Even more important, is that tracking down

Friend

on the Reservation

Douglas G. Hedin KΦOFB
219 Blanchard Blvd.
Syracuse 9, New York

causes of television interference (TVI) often are two-man jobs; the amateur sometimes needs help from the owner of the TV set, who obviously can't be of much help unless he knows something about the problem.

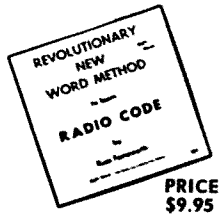
In the early days of radio, both amateur and commercial stations often operated on frequencies (dial settings) very close to each other. Because of this, and because we didn't know very much about radio, it was not uncommon for a home-owner to hear amateur stations on his house radio. However, as we learned more and more about electronics, and as newer frequencies came into use, home and amateur equipment was designed so that neither would interfere with the other, provided, of course, that both were constructed and operated properly. But then came television, and we had to start learning from scratch all over again. We still have a lot to learn!

A radio or television set is like your house. Your house has a front door through which you may invite in or keep out anyone you wish, with just a turn of a key. Similarly, you may invite in or keep out of your radio or television set any radio signals you wish, with just a turn of the dial. However, just as an intruder may break into your house or sneak in through an unlocked window, unwanted radio signals may find their way into your TV set, whether you invite them in or not, either because the signals are in the wrong place or because the lock on the electronic door is defective.

There are three primary causes of interference to television sets: (1) defective amateur equipment, (2) defective television sets, and (3) freak, unsuspected oddities of nature that occasionally appear (and sometimes disappear) unpredictably. Although each type of interference may look the same to the layman, the different types usually can be identified by an experienced amateur.

When the problem is traced to the amateur transmitter, the amateur merely locates the source of trouble within the transmitter and eliminates it. All amateurs have to take special tests, given by the Federal Communications Commission (FCC), to demonstrate that they know how to operate and maintain radio equipment properly. Once an amateur has

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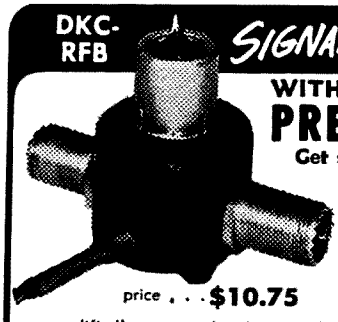
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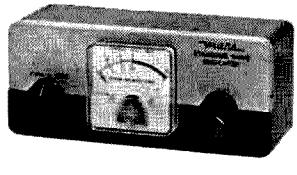
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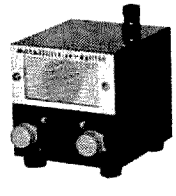
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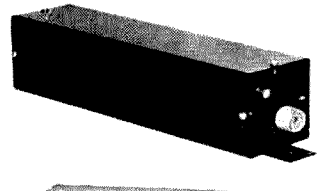
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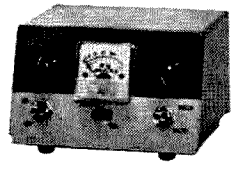
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passed these tests and has received his license, he may be fined heavily, or even imprisoned, if he willingly operates his equipment improperly. Such stern measures seldom prove necessary, however, because most amateurs are nice people and they believe in the high standards they are pledged to uphold.

A defective television set, on the other hand, presents a somewhat different problem. For example, suppose you have had your television set for a number of years and it has always worked fine (lucky you!). Then, an amateur station goes on the air in your neighborhood, and blooie; your television set has conniptions! What should you do? What *can* you do? Not knowing the answer can be more frustrating than the trouble itself.

Unfortunately, some television sets were not made to be used in close proximity to radio transmitters such as those used by amateurs. Certain circuits and types of construction were omitted because, at the time, they were not needed; there were relatively few television sets and even fewer amateurs. In addition, the extra features would have increased the cost of all television sets, not just those few purchased by people destined to live near an amateur station. Now, however, most television sets are constructed so that they will operate properly only a few feet away from an amateur antenna.

Should your television set prove to be defective, a competent serviceman probably can bring it back to tip-top shape again at nominal cost. In addition, the manufacturers of some of the early-model television sets will be glad to furnish, either free of charge or at cost, a modernization kit which a serviceman can install easily. Your serviceman probably can tell you the exact policy of the manufacturer of your set.

Fortunately, the third possible source of television interference, those gremlin-type unpredictables, does not occur very often. When it does, however, it usually is a first-class headache, because seldom does one of them resemble another. For example, in one case a rain-gutter was the culprit; in another case, the trouble was traced to defective house wiring; and in another, it was found that the amateur signals had combined with other types of radio signals to produce other, interference-type signals. A complete list of these freak circumstances, not to mention those that never could be figured out, probably would fill a dozen pages.

But regardless of the source of the interference, whether it is the amateur equipment, the television set itself, or whatever, the amateur will go the limit to help straighten things out. Then, when the problem is licked, he probably will invite you over to see his set-up and perhaps talk to a friend a thousand miles away (long-distance rates are *really* cheap on amateur radio).

KøOFB

(W2NSD from page 4)

which reduced the efficiency of that experimental project somewhat below the expected norm, however I feel that we should learn from our failures and use them as guideposts to the future rather than as monuments to the past."

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(Turn to page 71)

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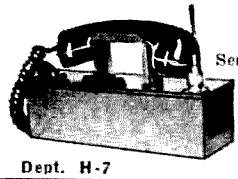
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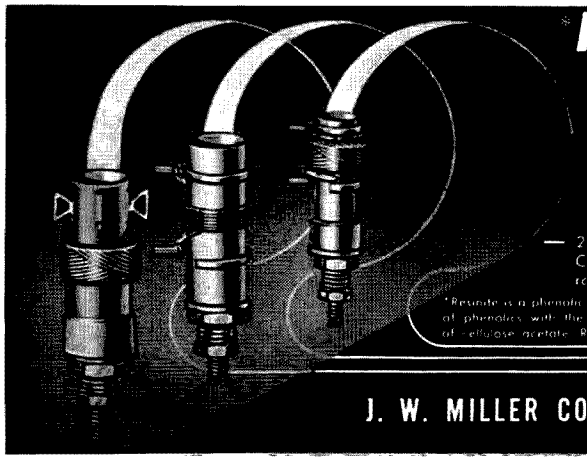
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(W2NSD from page 69)

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"If you are referring to the exaggerated reports in the papers about my connections with the company that has patented the special typewriters and stencils for our proposed new automated system, there is absolutely nothing to it. The small interest that I had in that company was turned over to my brother two years ago and I no longer have the slightest connection or interest in the company."

Help

This magazine is getting to be a little more than Virginia and I can handle all by ourselves, so we're looking around for someone to work with us. We'll be moving our office this summer and would like to find someone with a strong back for that, plus some building experience to help put in a very elaborate ham station.

I thought I'd mention it in case there happened to be any readers who might have a summer to squander in exchange for a little loot and a lot of experience. This could even be a career for the chap with the right background.

Author-Author

Perhaps you are not aware of the prodigious number of articles we have been publishing in 73. You may appreciate this more if you whip out a copy of QST and CQ and start counting. For instance, in the May issues of all three magazines we find that QST ran eight feature technical articles and CQ ran seven. Compare this with the twenty-six in 73 and you'll see what I mean. You may have noticed that we had not had to sacrifice quality in order to publish this volume.

How do we do it? Well, first of all we have an unequalled record of fast high payment for articles which has been bringing us the pick of the new articles. Our policy of paying for all articles on acceptance, a policy which brings home the bacon from one to three years sooner than many old hands at ham writing

(Turn to page 73)

ADDITION

The formula is simple: more pages in 73 mean greater weight per copy and this in turn means a larger postage bill each month. Multiply this by the threatened postal increase on second class mail and you have a new subscription rate before long. We hate it, but they have all the cards.

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Warning

If you don't order at least one of these specially selected books this month you are going to feel awful. This will be the combined result of your realizing that you've let another month of your life go by without improving your reference shelf and the guilt, shared with all other 73 readers, for reducing the Bookshop personnel to near starvation. This is such a humanitarian gesture all the way round that it should be tax deductible.

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13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. $6.00

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Now only $2.50

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ) Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable. $2.95

57A—HOW TO OBTAIN YOUR CITIZEN'S RADIO LICENSE—Orr $1.00

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. $2.95

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. $2.70

26—5-9 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. $1.00

27—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction, and operation of cubical quads. Build-it yourself info. Feed systems, tuning. $2.85

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. $1.75

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. $7.50

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. $8.50

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & Diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carriers through complete equipments. $3.50

58—ANTENNAS FOR CITIZENS RADIO — Orr (W6SAI). General coverage, mobile and directional antennas for 27 mc. band. Build and tune 'em. $1.00

80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. I (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO), SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube Index, cross index of A/N tubes vs. commercial types, TV & FM channels. $3.00

81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II. Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. $3.00

82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. $3.00

83—THE SURPLUS HANDBOOK, VOLUME I—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. This book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARC-5 VHF, ARN-5, ARR-2, ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, -1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF-11, Mark II, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. $3.00

731—HAM—TV—WΦKYQ. This is the only book available on this fascinating branch of ham radio. Describes complete ham TV station that costs under $50. $3.00

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(W2NSD from page 71)

had become accustomed to, has encouraged many of the established writers to get back to their typewriters.

If we are to continue to publish this vast rash of articles we have to have 'em coming in. This means that if you build something of interest to the gang it is up to you to see that an article is prepared on it and the information is passed along.

The rules are simple. Use a typewriter, double space, check the article for typing errors and spelling, make sure the schematics are clear enough for our draftsman to understand and have all parts indicated on the schematic. In the article tell just what people have to know to duplicate your efforts, but don't go on at length. Keep it short and sweet . . . the money will be long and green.

Mismatch

WØRUF is putting out a whopper of a bulletin out in Iowa. This is a strongly club-oriented publication and will be of interest to everyone in the Midwest. Subscription is $2.00 per year. This compliments Western Radio Amateur for West and Florida Skip for the South. Support your local publications.

High Power Mobile

There may be a few problems still to solve, but it looks as if Electra-Power has the best answer yet to running a mobile KW. E-P is now marketing a very small alternator (5" dia.) that will furnish over 2000 watts at 120 vac. This alternator is designed to mount on your engine and be driven from the fan belt or from a separate pully attached to the driveshaft. E-P has installation parts that fit almost all cars.

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So far, Electra points to several installations using their alternator successfully. The Swan and Collins transceivers are being used because of their physical size, but I doubt if it will be long before we see some higher power putting around.

If any of you fellows work up any mobile linear amplifiers to make use of this alternator we sure would like to have as much information as possible on it.

Delicensing

Such a high percentage of the hams around the world are really nice fellows that we have overlooked the few crumbums that have snuck into our midst. Maybe it is just because people come to me with their troubles, but I'm hearing about more and more miseries that just shouldn't be permitted to continue. I have watched with horror the procedure that the FCC has to go through to revoke an amateur license. It is unbelievable. We could rid ourselves of these conscienceless heels if the FCC would modify their system to permit more painless delicensing.

Suppose, for instance, a petition signed by ten amateurs were made grounds for an investigation. A fellow has to be pretty obnoxious if he is going to get ten fellows mad enough at him to have them register an official complaint. Then, at the convenience of the nearest FCC official, the petitioners, the offending ham, and any witnesses for either side could get together for a discussion of the situation. If the FCC official decides that the scoundrel obviously has been making trouble then his license should be revoked on the spot for a couple of years or permanently.

A procedure of this nature would take care of the mere handful of serious cases such as I have run into in my 25 years of hamming. Do we really want to protect amateurs who are nasty and uncooperative about TVI, fixing their rigs when they splatter, etc? Do we want to keep being annoyed by fellows who broadcast smut in our bands or who indulge themselves in biggoted tirades on the air? These people are, by our standards, insane and should be put off the air. And how about the few amateurs who devote considerable time to interfering with QSO's for the perverse delight in making people mad? Who needs 'em.

Mobile SSB

A few years back there was great interest in mobile operation. What happened to mobile? I don't know about everyone else, but my prob-

lem was one of compounded frustrations which finally discouraged me. By the time I got through trying to trick reluctant antenna coils into occasional performance I found that few fellows could hear my pip-squeak signal anyway. As soon as I encountered this setback with higher power my car battery committed suicide.

Never Say Die, says I. I met this turn of events with a higher power generator and a huge battery. After an intense effort to single-handedly boost sales of auto accessories via three of these generators, five regulators and two more batteries in dismal succession I threw in the towel and decided to wait for mobile sideband gear to come on the market so I could work out without having to muster up all those expensive dc amperes.

Mobile sideband did arrive, but not for me. I found that I had the choice of either of two well over $1500 units. With a sigh I decided to sit it out and wait for someone to work out a more economical arrangement. Sure, I know, if I had spent my time making money for myself instead of making others rich I could easily have enKWM'ed myself.

My waiting period is about over. By fall we should have a dozen different makes of sideband transceivers fighting for room under our dashboards. The Swan transceiver (advertised *only* in 73) was the first of the lower priced rigs to get into production. Their pileup of back orders was enough to convince even the hardest heads in the industry that transceivers are going to be "it" for some time to come. Some of the companies had their engineers working on their own transceiver design, others rushed out and bought a Swan to use as a prototype. One company even went so far as to buy a used Swan rig from another manufacturer that had just finished making their own carbon copy.

If as many fellows have been waiting around for this gear as I suspect we could have quite a boom in the ham industry this year. This would carry other products into high sales too: noise silencing kits put out by Sprague and Johnson, mobile antennas and mounts, microphones, alternators, ad infinitum. Try to stick to 73 advertisers as much as possible, eh?

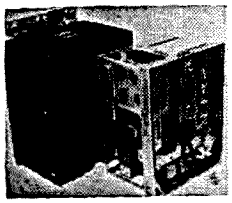
July Last Year

We have a good supply of last July on hand. This was quite an issue and you should have one in your files. The lead article was on portable two meter antennas and described a

(Turn to page 76)

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(W2NSD from page 75)

simple system for making up all sorts of exotic antennas out of easily available materials. We have had many letters of approval on this article. Next we ran an interesting article on how to hook your mobile rig to any passing water towers in order to put out a whopping signal from the car for emergency purposes. Then there was a fine two meter nuvistor preamplifier for souping up your old converter or receiver. W7CSD's article on AM Modulation Systems was clear and lucid and brought a great deal of understanding to an obscure subject. K5RPB explained how to figure distances on the globe from longitudes and latitudes. W3QA discussed doings on the very low frequencies and described a simple converter for listening to these frequencies (10 - 30 kc). K8NIC's little transistorized six meter converter has found its way into a lot of cars during the year since it was first published. Two transistors are used.

The July issue had part II of the New Panadaptor unit. This described the construction details and operation of the gadget. This unit hooks your shack scope to your receiver so it becomes a panadaptor. K6UGT explained how to plate modulate the DX-40 and other similar rigs. Sockets for the 4-1000A are hard to come by, W4API described a substitute. Then there was an article on measuring frequency accurately using simple equipment.

One article that is still bringing comments is "From My Side Of The Counter" by W2BNW, one of the dealers down on New York's famous Radio Row. K6EAW did a beautiful job of explaining how to set the bias for transistor stages. This was particularly interesting because it was a practical article and didn't horse around with a lot of formulas. Our Big Technical article for July, in addition to the Modulation article, was on power supplies. This covered regulated supplies, zener diodes, silicon diode supplies, etc. Another little construction project was the K1NFE Band Edge Marker, using a 3.5 mc crystal. W8KTJ wrote up a little demonstrator for showing how transformers work which will be valuable to anyone who is trying to teach electricity fundamentals.

There were a few smaller articles and our most unusual cover to further warrant your investing in this issue. If you want it send 50c. This is a good buy for 18 articles, all still topical.

Wayne

The National NC-303 is not for every amateur...

Frankly, the NC-303 is an expensive receiver. And not every ham is willing to spend $449 to enjoy the maximum in receiving convenience and performance. The NC-303 is not a "compact" light weight. It's packed with 78 pounds of husky components to provide a little bit better reliability and performance than the next receiver. The NC-303 offers certain advantages. Sensitivity, for example, is an honest 1.0 microvolt or better for 10 db AM signal-to-noise ratio (this is not a misleading CW measurement or one based on a 6 db S N), and the NC-303 is quiet — no operator fatigue from background noise bursts.

Selectivity is remarkable (six tuned circuits at 80 KC result in extremely steep skirts on SSB and CW) . and the '303 offers the widest selectivity range available on any hamband receiver — 400 cycles through 8 KC. Stability, both mechanical and electrical, is quite out of the ordinary. No need to tip-toe around the shack. In fact, tune a CW signal and employ the classic "drop test" to see for yourself. Incidentally, we consider 100 cycle thermal drift after a short warm-up to be unusual.

"This is all very well", you may say, "but not a great deal better than competitive receivers" We agree — for four hundred and fifty dollars you should expect much more than this, and so we give more to you. The most expensive dial drive in the industry to provide smoother inertia tuning than any receiver on the market, regardless of price. The NC-303's band switch mechanism even employs a Geneva movement . . . you just start it on its way . . . it does the rest of the job by itself. No wiggling back and forth to make sure every contact is engaged. This switch snaps in with a satisfying clunk and stays there. (Try tuning a signal on one band, then flip to another band and back again.)

Other extras include complete coverage from 160 (by the way, the '303 is the only SSB hamband receiver now on the market which incorporates 160) through 1¼ meters with separate 12" slide rule drum dials for each band, and accessory converters are available for the three VHF bands. Even a separate converter input is provided. Dial calibration is to 1 KC on the lowest band, to 2 KC through 15 meters.

The '303 also offers the best SSB AVC you've ever heard. No pops, thumps or distortion . . . just a constant gain level through local or DX QSO. There's an audio response control for CW peaking or VHF scatter work . an active nulling Q multiplier for 50-60 db notches, complete with depth control an unusual noise limiter which cuts impulse noise without signal distortion, plus adjustable CW SSB limiting. Even external provision for RF gain control for CW break-in operation and an accessory socket for receiver accessories or adapters are included.

The NC-303 was not designed to meet competitive price or performance, but to provide maximum hamband performance for every type of operation. Not just SSB, not just AM, not just CW but every mode. As a result, it costs more than the average ham receiver. On the other hand, if your requirements are for more than "the average", perhaps the '303 should be your next receiver. Why not operate one soon and find out?



NATIONAL ONE YEAR GUARANTEE

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73

August 1962
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Wayne Greeen W2NSD—Editor, etcetera Phone: (603)—WA 4-3873

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de W2NSD/1

never say die

The moving of offices that was casually referred to in the last editorial turned out, when reduced to practice, to be quite a process. It is a big deal for an ordinary family to move across town. Your imagination would be staggered at the amount of ham gear that I have gathered down through the years. I was staggered when I looked it over. And all this had to be packed up and moved 250 miles!

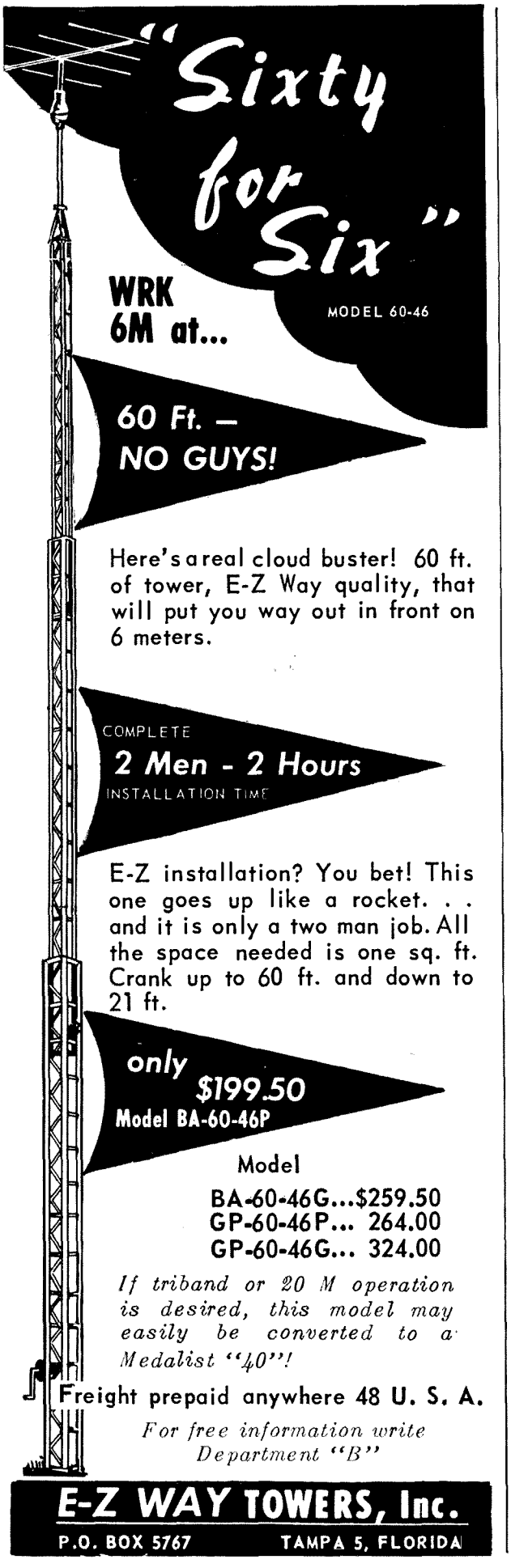
One of the commercial movers came out to give me an estimate. He blanched. I had expanded to fill three and half garages, all of a seven room apartment and a good deal of a full sized house. He calculated $2000 if we did all the packing, but I got the idea that this might turn out to be low once they found out how solidly packed those garages were and how heavy radio equipment is. I started calling rental truck companies.

U-Haul seemed to have one of the best prices so I rented one of their 16-foot vans and started loading. It held a lot more than I thought it would. Even with Virginia, me, our subscription man and two local hams pitching the stuff in, it still took a full day to fill it up. Perhaps we were a little too enthusiastic in the loading for when we stepped back to survey the results we noticed that the truck springs were bent backwards and the six tires almost flat from the weight. It was obvious that the truck could never make it.

It did come close though. It got to within one half mile of the house in Peterborough before one of the tires exploded. Luckily the tire vaporized right in front of the local Gulf station, winning them the job of trying to locate a jack strong enough to allow repairs. It was a warm day and the first jack sank into



New Headquarters Building



the pavement instead of raising the truck. A larger jack was found and pressed into service. This one did better. It got the truck up high enough for the two wheels to be removed (the inside tire blew out, of course) and then crumpled, dropping the truck on it axel and almost toppling the whole works. By the next day they had enough jacks rounded up to get the truck up and a new tire in place. They had quite a time of it.

The second truckload was much lighter, being mostly office desks and furniture. This truck made it all the way to Springfield, Mass., before quietly expiring by the roadside. Oil leak. After a few long distance calls U-Haul scouted up another truck as a replacement and provided a man to help us change the load.

I decided to have a try at changing my luck. The third load went up in an Avis truck and made it without incident. That was worth a lot more than the $10 difference in rental rates. The fourth load also went via Avis. This leaves one more load yet to go. What an accumulation! It is a monument to years of buying bargains in the local radio stores.

Open House August 19th

We're real proud of this new 73 home and would like to have you come on up and say hello. Since we are still going to continue short handed for some time it will be a bit unhandy for us to have people visiting at random . . . we work a 16 hour day seven days a week and still only get half the things done that we should . . . it will be much more convenient if the visiting takes place sort of between our press dates when we have a little more breathing time. The best time for us would be on Sunday, August 19th. I doubt if we will have much straightened up by that time, but at least there will be room for you to get from one place to another and we see what we're up to. Come on up. If you can't make it on the 19th, but find yourself in the area, drop in anyway.

The house is located right on Route 101, just East of Route 202. You can't see it very well from the road due to the high hedge around it. You turn up Pine Street and then right in the first driveway. We'll have some sort of sign up for you. Please, no gifts. I'd like to serve some sort of refreshments, but since I have no idea whether there will be two or two hundred visitors I guess there is no way to do it!

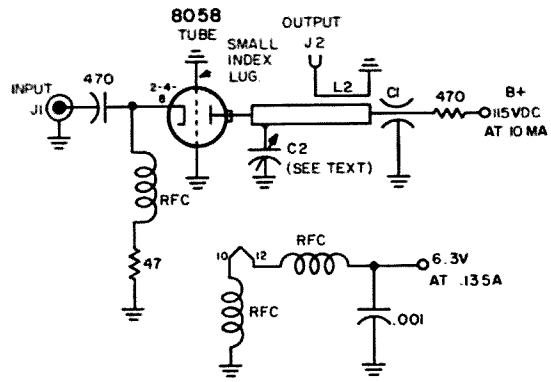
(Turn to page 70)

Coaxial Line UHF Preamp

using nuvistors

Ronald M. Vaceluke W9SEK
Buckhorn Ranch Trailer Park
Lot B39
Des Plaines, Illinois

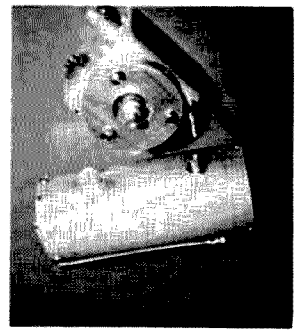
ALTHOUGH nuvistors have been on the market but a short period of time, they have been very popular in ham construction due to their high performance at low cost. However, as frequency rises, so do the problems involved. At 420 mc it becomes difficult to get the control grid at rf ground potential. This is because the familiar 6CW4 has but one grid connection and it is small in area. RCA obviously recognized this fact and brought out the latest nuvistor, the 8058. This gem has the control grid connected to the small indexing lug on the tube and becomes grounded when the tube is inserted into the socket. Due to the design, the 8058 is rated

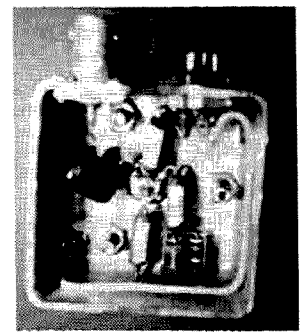


to 1200 mc and lends itself to coaxial tank circuit configurations. With this in mind, I set out to build a pre-amp for 432 mc.

Construction

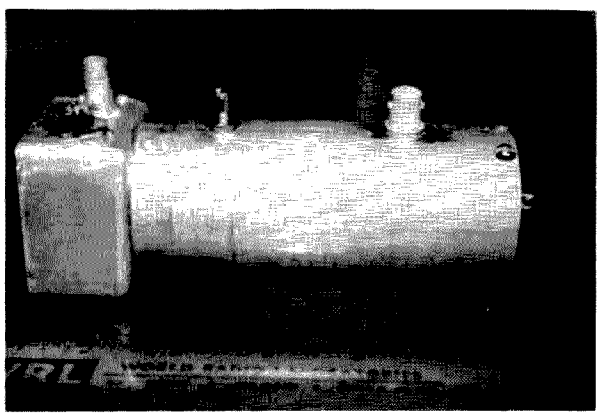
The general construction features can be seen from the photos and sketch; however, a few additional words are in order. The major portion of the tank circuit is constructed of brass. The two end pieces are ¼ inch thick and turned to size on a lathe. The far-end piece has a hole made to fit the plate by-pass capacitor. A mica feed-thru was used for the sake of simplicity. The one used is a surplus job which fits into a ½ inch hole and is held in place with two set-screws. The "cold" end of the inner conductor (L1) is soldered to one end of this feed-thru. The plate end of L1 has a ¼ inch hole drilled into it and, along with cross saw slots, makes a very usable plate connection. The plate tuning capacitor is a surplus unit much like a small Johnson type "M." It has four stator and five Rotor plates. The two stator support rods are cut so they partially straddle the inner conductor and are soldered to it. When soldering, be sure the

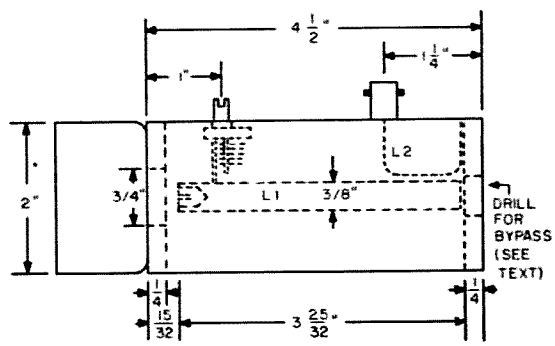




line L1 is centered within the tank. This provides alignment for the tube plate cap when assembling the unit. The end piece near the tube has a ¾ inch hole drilled thru it to pass the nuvistor. Both end-pieces are fastened to the outer line with three 6-32 screws on 120° centers.

The tube, socket, and all other associated circuitry is in the chassis (LMB #MO-18) which measures 2" x 2" x 1¼". The socket must be soldered to the chassis to be sure of a good rf ground. Parts layout can be seen from Photo #3. All power connections are made through the connector (Amphenol #126-010). The means by which the dc plate connection is made can be seen from Photo #2. A small feed-thru capacitor is soldered to a corner of the chassis with a phone pin plug soldered to the capacitor. A mating phone pin jack is soldered to the outer shell of the tank. When the tank is removed from the chassis for tube replacement, the B+ is dis-





connected. This saves having to unsolder connections for servicing.

This may seem like a difficult way to get a pre-amp for UHF, but it is more satisfactory than lumped constants. No guesswork is used in finding the sizes of the tank configuration as this is calculated easily by mathematics. Many may rebel at the thought of machine work, but most hams, I'm sure, must have do-it-yourselfers as friends that can do the work. My thanks to my father for his assistance and machine work.

. . . W9SEK

C1—mica feed-thru
RFC—Ohmite Z-460
L1—Inner line ⅜" x 3-25/32"
L2—Output link, 1" long near L1
J1—BNC, UG-290/U
J2—BNC, UG-625B/U
Socket—Cinch #133 65 10 001
Chassis—LMB #MO-18

Improving the CC50

Larry Levy WA2INM

Like many other hams who read only the price tag when they are shopping for a piece of equipment, I found myself with problems when I got home and tried out my new possession. In this case it was a Tecraft CC50 converter with which I had hoped to get into the DX race for WAS on 6 meters

This item may do well up in Maine, but down in Brooklyn the strong locals rode in over every signal and ruined my disposition for almost a week. I finally decided that these fellows were not going to get off the air just because I had problems, so I got out the tools and soldering iron to see what could be done.

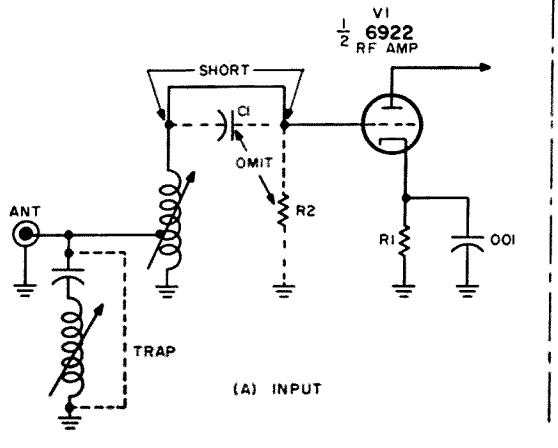
While I had it apart, I also devoted some time to improving the noise figure, which looked like it could stand some improvement. I am happy to report that with only a few modifications, the CC50 turned into a satisfactory converter.

The front end was first. C1 and R2 were removed and the hot end of the antenna coil was connected directly to the grid. The substitution of an Amperex 6922 for the 6BZ7 really made an improvement. The 6922 is a dual triode using frame grid construction (see 73, November, 1960 for more information on frame grid tubes). Both gain and noise figure were improved. (The transconductance of the 6922 is over 12000 and the noise figure was considerably lower than the 6BZ7). The 6922 shouldn't present any problems with neutralization. Although the 6922 costs slightly more than the 6BZ7, it is a worthwhile investment and it will probably outlast several 6BZ7s. (It is one of the Amperex PQ 10,000 hour tubes). It usually is a good investment to spend the extra money for tubes like this as the cost per hour of useful life is lower than ordinary tubes. The only circuit change needed for the 6922 is that the value of R1 be changed to 680 ohms.

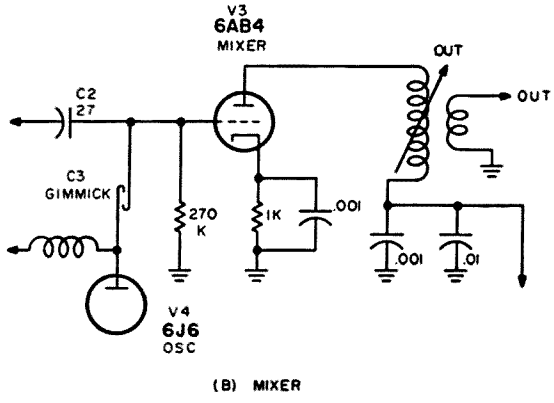
This left me with a converter that had a better noise figure but still had susceptibility to cross modulation. In this converter the cross modulation takesplace in the mixer stage. To overcome this problem, I decided to change to a triode mixer using slightly higher bias. The triode mixer will also have a slightly lower noise figure, although it is debatable if this will help reception of weak signals as the mixer is preceded by two stages of rf amplification. A 6AB4 was chosen for a mixer tube because they work well at the higher frequencies and also because I had one in the junkbox. Change the coupling capacitor (C2) to about 27 mmfd if it is any smaller than that value. (For some reason, several of the converters I have seen have different values for that condenser). Increase the value of the gimmick capacitor used for oscillator injection (C3) by twisting the wires around a few more times. The other values should be changed according to the schematic. The coils resonate without change. This reduced the cross modulation to a very low level.

It is well worth the time spent in this conversion, the amount being about one-half hour. Although this conversion only covers the CC50, there is no reason why these modifications could not be employed in similar converters, or for converters for a different band.

. . . WA2INM



(A) INPUT

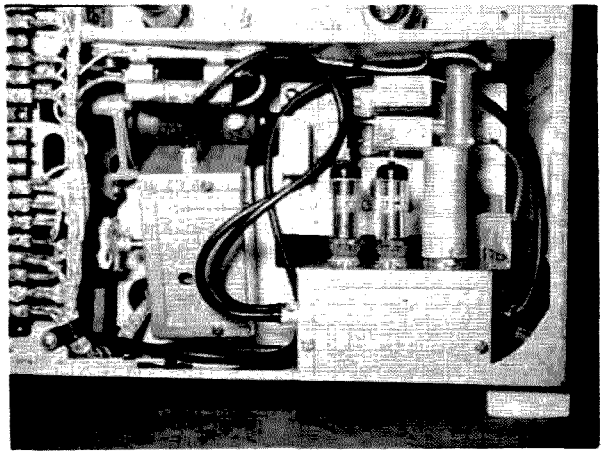


(B) MIXER

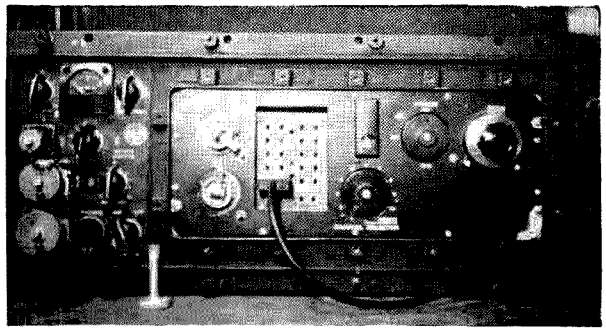
VHF with RDR

Martin Kaiser W2VCG
Raymond De Vos W2TAM
140 Summit Avenue
West Trenton, New Jersey

IN keeping with the general increased interest in the VHF bands, it is only fitting that any suitable and available surplus equipment should be brought to the attention of fellow amateurs in order to further occupancy of these bands. The unit in question is the Navy Model RDR receiver. This receiver was a companion unit for the MAR radio equipment and anyone fortunate enough to own the complete MAR equipment can connect the furnished cable from the RDR to the MAR power supply and he is in business. For others, a separate power supply will have to be built. The RDR is a crystal controlled superheterodyne receiver with a given range of 225mc to 390mc with the crystals supplied, but by the use of other crystals it is possible to cover the entire 220 mc amateur band without difficulties. Input voltages are 13V dc or ac and 375 V dc for the plates. Antenna input is approximately 50 ohms which makes it suitable for the standard multi-element beams fed with RG/8U, RG/11U or RG/14U. Size of the receiver is 21 x 16 x 9 and weight as sold, uncrated, is 45 lbs. Removal of the dynamotor lightens the unit considerably. The dynamotor, by the way, is an excellent 13V dc input job with 385V at 500ma out and could very well be used to power some mobile equipment. The RDR in the present day market can be bought for about $25 plus shipping from MDC industries and from Meshna Enterprises. It will be found that most units are brand new complete with manuals and crystal oven and tubes. The only item not included is the power plug, and that can be obtained by ordering AN3106A-16-9S from any radio parts supply house.



Interior view showing VFO mounting in dynamotor compartment. The flexible porcelain coupling is visible at the left, and resistor R2 can be seen above the tube shield of the 6417.



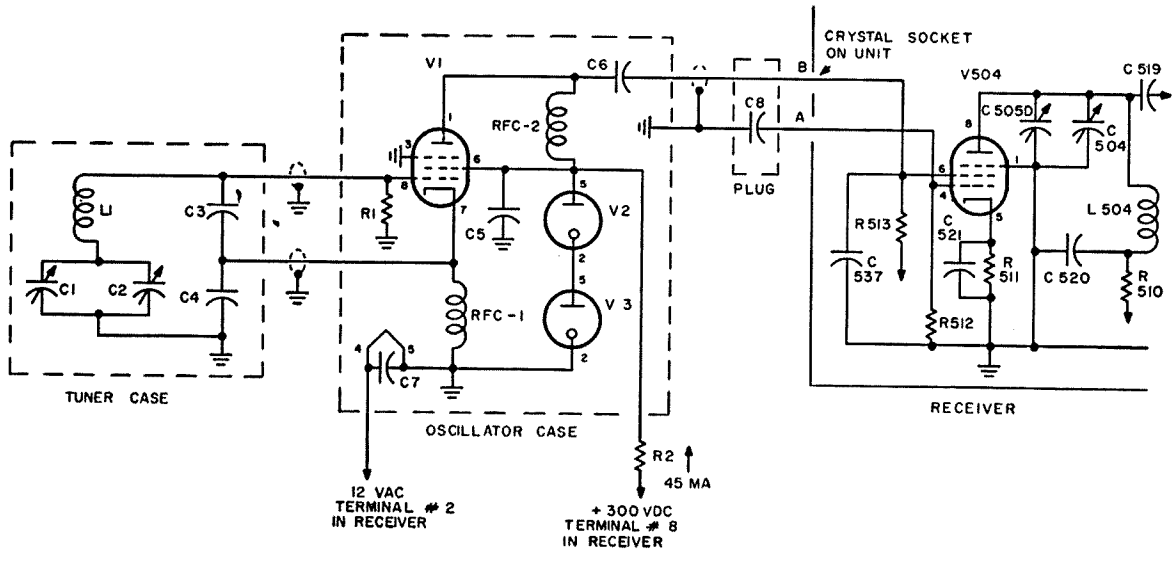
Front view of RDR showing VFO vernier dial at right, output cable with DC-30 holder plugged into #1 crystal socket in the center, and vernier tuning knob in front at the left.

It is difficult to understand why so few

MDC Industries, 933 North Schiller Street, Philadelphia, Pa.
Meshna Enterprises, Lynn, Massachusetts

VHF amateurs have latched on to this gem, unless the crystal control feature has been the deterrent. Crystal control is not the most desirable receiver arrangement, but this article will show how to make this a completely tunable receiver without altering the original arrangement. The operator will then have the choice of either a tunable receiver or a ten channel crystal controlled receiver. It should be added at this time that the conversion described is by no means the final one. The VFO unit could be reduced in size and could be housed in one box. The power supply could conceivably be made small enough to fit into the remaining space vacated by the dynamotor, the *if* system could be returned to narrow the band-pass and a nuvistor preamplifier might work wonders as far as sensitivity is concerned. As can be seen, there is still plenty of room for improvement and none of it overly difficult. A glance at the schematic of the VFO unit will show it to be straightforward. The unit as built and shown in the photograph is in two miniboxes. This was intended as an aid to stability, but in view of the fact that the entire unit is in an enclosed area the two box design perhaps adds very little to overall performance as compared to a single box. Power for the VFO is taken directly from the barrier strip located toward the front of the receiver. Terminal #8 for B plus and terminal #2 for the 13V filament circuit. The ground return wire can go to any convenient spot on the chassis. The dial hole, already drilled, is the one in which the knurled venier tuning knob was stored. By drilling the rivets from the retaining spring clips and removing them, the surface is disengaged. Over this hole is mounted a 2" vernier dial of the type currently sold by all supply houses. In order to get proper alignment a flexible porcelain coupling is used to connect the tuning capacitor C1 and the dial mechanism together. The coupling will take care of any strains due to misalignment. After the VFO has been assembled and installed, locate the range of 4.5kc to 5 kc. This may require adjusting the trimmer C2. The 220mc to 225mc band falls within this VFO range. Using a signal generator with output on 220mc, and the VFO at the low end, or 4.63kc, with Multiplier dial and rf dial on the receiver set near zero, it should be possible to tune in this signal. Once the signal has been located the rf dial may be locked in position. It will be necessary, however, to move the multiplier dial one division when going from the low end to the high end of the 220mc band. This dial will have to be locked when going from crystal position #1, or VFO, to any other crystal position with autotune mechanism. Crystals used should be in a type DC-30 holder and the frequency is calculated by the following formula: Crystal (or VFO) frequency x 18 minus 10.066mc x 3 equals receiving frequency. Good luck, and see you on 220mc. . . . W2TAM & W2VCG

C1—Johnson 9M11 .....
C2—8-50 mmfd rotary ceramic ....
C3-C4—1000 mmfd silver mica ....
C5-C7-C8—.001 mfd disc ceramic ..
C6—.005 mfd disc ceramic .....
L1—50 turns #24 closewound on ¾" form .....
R1—51K ½ watt
R2—1800 25 watt
RFC1, RFC2 } 2.5 mhy
VI—6417
V2-V3—OB2



For DX or contests . . . for scatter, aurora or satellite tracking . . . for "rock-crusher" reports or just plain "chewing the rag" . . .



HERE'S THE VHF COMBINATION THAT BEATS 'EM ALL!

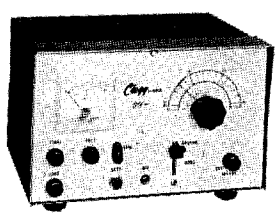
Put yourself behind this power-packed Clegg VHF ham station . . . **we guarantee** you'll "out-talk", "out-receive" any other commercially-built amateur VHF transmitter and receiver now available!

Take, for instance, Clegg's ZEUS VHF Transmitter. It gives you full coverage of the amateur 6 & 2 meter bands and associated Mars frequencies, with maximum TVI suppression. Automatic modulation control with up to 18 db of speech clipping provides magnificent audio with "talk power" greater than many kilowatt rigs. This beautiful unit with its ultra-stable VFO is the ultimate in VHF equipment for amateur and Mars operation.

Clegg's all new INTERCEPTOR VHF Receiver, designed for the serious operator on these bands offers performance features unmatched by presently available equipment for these frequencies. Exactly matching the famous Zeus Transmitter, the Interceptor offers reception with virtually no cross modulation. Nuvistor RF stages provide an extremely low noise figure with high sensitivity. Stability is ideal for the exacting requirements of SSB and CW.

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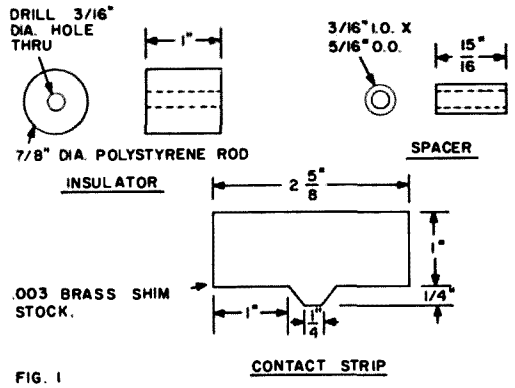


FIG. 1

THIS antenna was born of a lack of space, money and a desire for simplicity; the article to satisfy the pleadings of many of my ham friends, for whom I didn't have the time to make individual copies of the plans for this antenna. The majority of the materials are airplane surplus and the total cost of the antenna is less than five dollars.

Basically, this 50 to 54 mc antenna is a half-wave vertical radiator fed at the center. It consists of a projecting upper quarter-wave section called the whip, and a lower quater-wave section called the skirt. The feedline passes up through the skirt to the center insulator. The center conductor of a 72 ohm (RG 59/U) coaxial feedline is connected to the whip and the shield is conected to the skirt. This is accomplished by the special design of the center insulator.

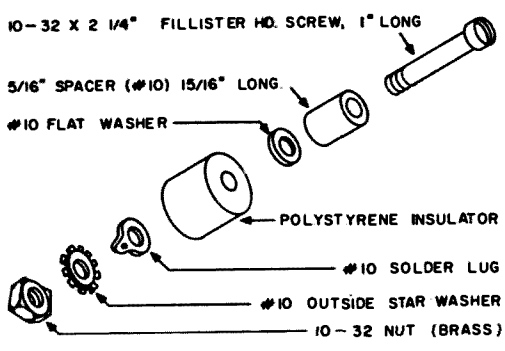


FIG. 2. INSULATOR ASSEMBLY

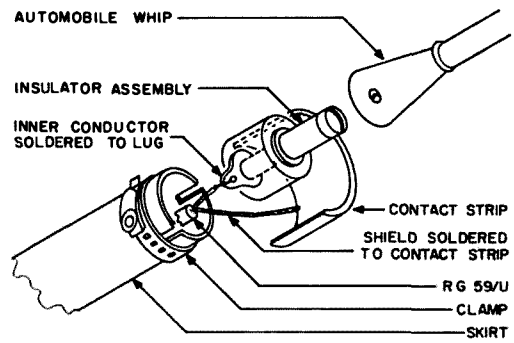


FIG. 3

The skirt of the antenna serves a two-fold purpose. Since it is half of the radiator, or one quarter-wave length, it also behaves as a trap providing an infinite impedance such that no appreciable current flows back down the feeder.

The whip is a commercially manufactured automobile replacement antenna, which when fully extended has an overall length of 58 inches. The skirt is made of 1 inch diameter aluminum tubing with a wall thickness of 0.049 inches.

A 6 foot length of tubing is cut to 55 inches for the skirt and the remaining 17 inches is used for the support tube. Both ends of the skirt and one end of the support tube are slit across the diameter of the tubing with a hacksaw containing a 1/16 inch blade to a depth of 1⅛ inches.

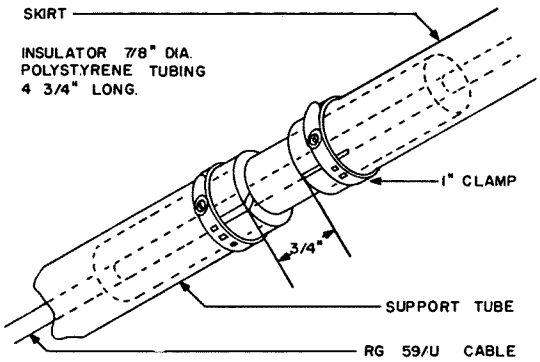


FIG. 4, INSULATOR AND SUPPORT TUBE ASSEMBLY

The insulator is made from a 1 inch length of ⅞ inch diameter polystyrene rod with a 3/16 inch diameter hole drilled length-wise through the center (See Fig. 1). The insulator assembly (See Fig. 2) is made with the insulator, 10-32 x 2¼ inch fillister head screw, spacer (1 inch long, 5/16 inch diameter) no. 10 flat washer, no. 10 solder lug, no. 10 outside star washer, and a 10-32 brass nut.

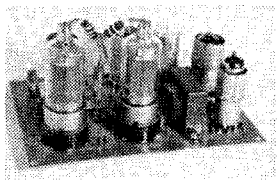
A contact strip is made from 0.003 inch brass shim stock (See Fig. 1) which is wrapped around the insulator before inserting into the end of the skirt. A 78 inch length of RG 59/U coaxial cable is used for the internal feedline. The RG 59/U cable is stripped at one end and the outer connector (shield) soldered to the tab on the contact strip, with the center conductor soldered to the lug on the insulator assembly. The other end of the cable is passed through the skirt with the insulator and contact strip inserted into the skirt end. A 1 inch clamp is slipped over the end of the skirt and fastened tight to hold the assembly firm (See Fig. 3).

The support tube insulator is a 4¾ inch length of ⅞ inch diameter polystyrene tubing with a ⅛ inch wall thickness. The tubing is slipped over the end of the coax cable and inserted 2 inches into the lower end of the skirt. A 1 inch clamp is positioned over the end of the skirt and tightened to secure the insulator. The support tube is slipped over the remaining free end of the insulator allowing ¾ inch spacing between the skirt and the support tube. A 1 inch clamp is positioned at the top of the support tube tightened securely (See Fig. 4). The antenna is completed by installing a PL 2 59 connector to the end of the cable and fastening the whip to the insulator assembly. The antenna can be mounted with any standard TV antenna mounting hardware.

Using the Gonset Communicator and this antenna the writer has received many excellent reports. . . . W6KVO

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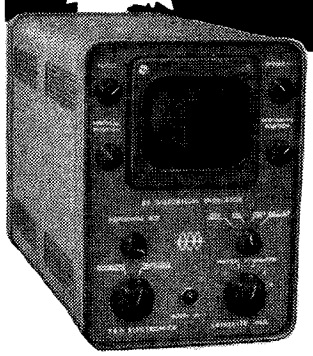
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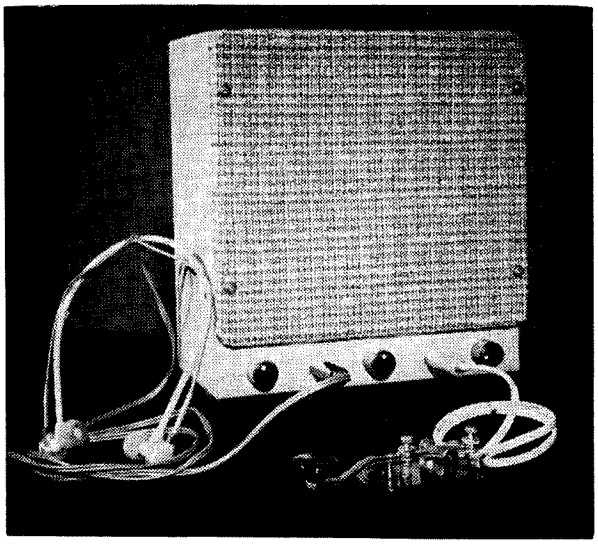


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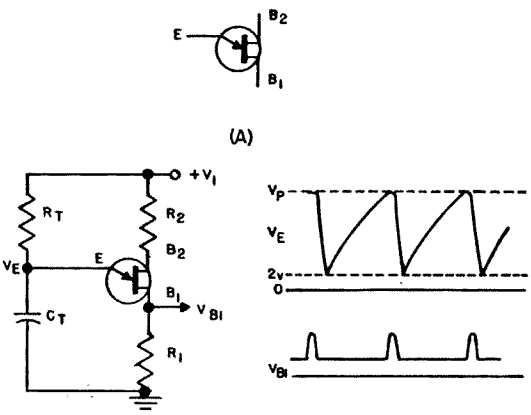
The Uni Transistor Code Practice Oscillator

THE "Uni" is the result of what started out to be a simple and quickly constructed code practice oscillator using a single transistor to drive the ham shack loudspeaker. The original plan was to have a little gadget handy, and always ready, so when things got dull around the shack, or when fancy struck, it would be a simple matter to give the ole fist some practice. But like the fellow who decided that a little red paint on the trim of his white house would really look sharp and then ended up painting the whole house red, so too the "Uni" ended up being painted red, so to speak, and got the complete treatment. As things stand now the "Uni" doubles as the shack loudspeaker as well as a complete portable code practice oscillator.

"Uni" was chosen as a name for two reasons: first, a single transistor only drives an 8" loudspeaker to reasonably loud volume; and second, the transistor doing the driving is a Unijunction, or UJT. The UJT (2N2160) is an unusual transistor. Although it is similar to other transistors in outward appearance, it is, in its own right, unique. Even the symbol is unique as can be seen in Fig. 1(A).

The Unijunction transistor, like most transistors, is a three terminal device. It is different than most, however, in that it displays a negative resistance characteristic between its emitter (E) and base-one (B1) terminals. Some UJT electrical characteristics resemble the gas thyratron, but here the similarity with other devices, tube or semiconductor, stops. The remaining electrical characteristics are unique and the Unijunction transistor has no exact counterparts either among solid state or vacuum tube devices.[1] Although the Unijunction is available in a variety of types to meet a variety of needs, and at higher cost than the amateur likes to pay for a transistor, the 2N2160 is a low cost type well suited for amateur experimental work. Because of the unique characteristics such applications as oscillators, timing circuits, trigger circuits, and bistable circuits become simple to design, easy to construct, and precise in operation.[1]

The Unijunction transistor relaxation oscillator shown in Figure 1(B) is the basic oscillator from which many interesting circuits can be derived. In fact, the "Uni" was the outcome of replacing R1 with a loudspeaker and adjusting RtCt for medium to high frequency oscillation. By keying the +V1 battery line, current is drawn only during key-down



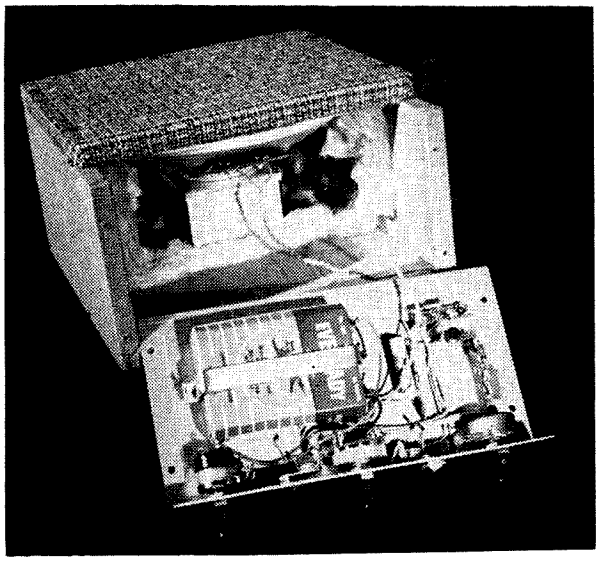
BASIC UNIJUNCTION TRANSISTOR RELAXATION OSCILLATOR – TRIGGER CIRCUIT WITH TYPICAL WAVEFORMS

(B)

FIGURE 1.

periods and the result is an extremely simple and economical code practice oscillator consisting of speaker, two resistors, one capacitor, a battery, and a UJT 2N2160. How simple can a circuit get!

Let's look at Fig. 1(B) and briefly go over how the UJT basic relaxation oscillator works. At the beginning of the operating cycle the emitter is non-conducting since no operating voltage is being applied. Applying voltage at +V1 terminal allows capacitor CT to charge through resistor RT. As the emitter voltage at point VE rises exponentially towards the level of +V1, the supply voltage, a point VP, the emitter's peak point voltage, is reached. At this instant the dynamic resistance between the emitter and base-one drops to a low value.



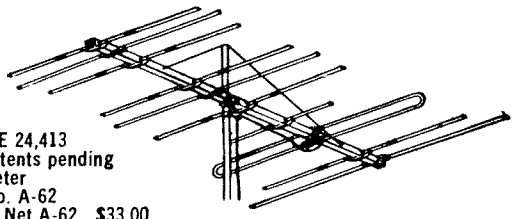
Capacitor CT then discharges through the emitter and through R1 to ground. As the emitter voltage VE approaches 2.0 volts the emitter no longer conducts and the cycle is repeated. The resulting series of pulses are shown as VB1.

Frequency is determined by RT, CT, and the voltage across the UJT. By including R2 in base-two the effective voltage across the UJT is stabilized with respect to temperature. Excellent frequency stability can be obtained from the UJT basic oscillator when R2 is between 50 and 500 ohms. Those interested in pursuing the UJT further can refer to the biography. Detailed theory of operation and specific applications of the UJT far beyond the scope of this article are treated by the authors in the papers listed. This being a construction article, let's get to building the "Uni."

Fig. 2 shows the completed "Uni." It goes without saying that you need not duplicate the circuit as shown. By replacing the tone

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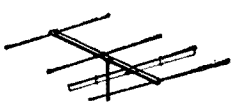
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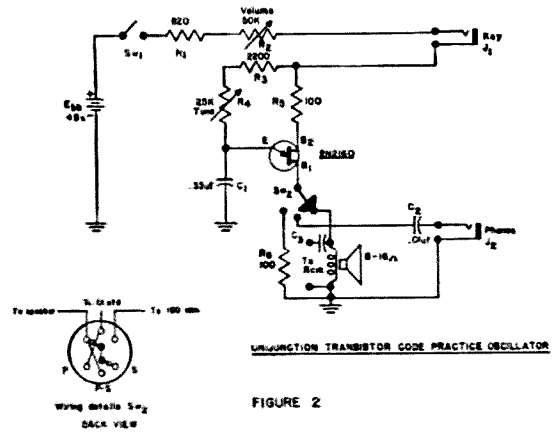


FIGURE 2

and volume controls along with their series limiting resistors, R1 and R3, with single fixed resistors, eliminating the switching arrangement, and using the shack speaker, an economical and simple but satisfactory code oscillator will be yours. Volume and tone will be fixed but this is more than compensated for by the few parts used.

A 45 volt B battery is used to power the "Uni." The battery selected, an RCA No. 455, was readily available and fits with ease into the cabinet. This can be seen in the photograph. A clamp is used to secure the battery in place. The clamp allows for spacing the battery ¼" from the chassis surface by shimming with a scrap piece of wood or plexiglass. This allows the battery terminals to clear other surrounding terminals and components. Actually 45 volts is more than required for the 2N2160 and in order to limit the base-to-base voltage to the manufacturer's recommendation of 30 volts maximum, an 820 ohm limiting resistor in series with the 50 K volume control must be used. Some slight change in tone will be noted when the volume control is rotated from one end to the other. Limiting resistor R3 prevents excessive voltage being applied to the emitter when tone control R4 is adjusted to minimum. Battery drain, depending on volume setting, is from a half milliampere to 10 ma.

Switch SW1 is strictly a precaution to save the battery from being drained by curious little hands when the Chief Operator is not around to supervise. Considering that the oscillator is keyed in the B+ line, and when the key is up the oscillator draws absolutely no current, SW1 could be left out. Selector switch SW2 allows for three modes of listening: phones alone, phones and speaker together, and speaker alone. Wiring details of the two circuit–three position switch is also shown in Fig. 2. Although the basic UJT oscillator circuit, because of its simplicity and few components, can be stuffed into almost any space, some may wish to build the "Uni" as shown. Cabinet size will naturally depend on the size of the loudspeaker. An 8" General Electric Model 850D loudspeaker is used in the "Uni" here shown, but just about any loudspeaker may be used with equal results.

A word about C3. C3 acts as a dc blocking capacitor when the "Uni" is connected to the home receiver. This capacitor prevents the low resistance winding of the receiver's output transformer from dc shunting the speaker voice coil. Should this happen a serious decrease in volume from the "Uni" will result because of the current pulse from base-one splitting and flowing through the two parallel paths. C3 prevents this. Low audio frequency roll-off will result from using C3, depending of course, on the value used. A 2 mfd, or larger, capacitor should not cause too serious a roll-off in most ham installations.

To date the "Uni" has seen service at the recent ham family picnic, taking part in the QLF contest. It was loud enough to be heard at a good distance with a crowd surrounding the contestants. It has also been used to teach several code groups. In each instance it has come back home with flying colors, accompanied by such comments as, "Plenty of volume—pleasant tone—how about a copy of the circuit?" To say the least we're glad we gave the "Uni" the complete treatment. It was worth it! . . . W2VSP

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S. R. Brown, T. P. Sylvan, "The Silicon Unijunction Transistor," **Electronic Design**, January 8, 1958, pages 56-59; January 23, 1958, pages 30-33.
T. P. Sylvan, "Applications of Unijunction Transistor Relaxation Oscillators," **Electronic Equipment Engineering**, May 1958, pages 51-56.

Parts List

C1—.33 μfd
C2—.01 μfd
C3—See text
Battery—45 V "B" Battery. RCA No. 455 or equivalent
J1—Open circuit key jack
J2—Open circuit earphone jack
R1—820 ohm ½ w.
R2—50 K volume control with SPST Switch
R3—2200 ohm, ½ w.
R4—25 K Tone Control
R5—100 ohm, ½ w.
R6—100 ohm, ½ w.
Sw1—SPST switch mounted on R2
Sw2—2 circuit, 3 position rotary switch (Mallory Type 3123J)
Speaker—8—16 ohm 8" speaker
Misc. 3 single mounted terminal strips
1 two lug screw type terminal strip
4 Rubber feet
3⅝" dia. knobs
Transistor—2N2160 Unijunction

More on Crystal Oscillators

Murray Baird W6LWE
1231 10th Street
Manhattan Beach, California

THE crystal oscillator article in 73 Magazine, September 1961, did a fine job of surveying the countless ways of tickling those fascinating little quartz slabs into doing their duty. To my mind, though, it skipped rather lightly over the Colpitts family of oscillators. Since this basic circuit is rapidly becoming the favorite of a goodly number of designers, some added remarks on its care and feeding might be in order.

The Colpitts offers a number of advantages which are difficult, if not impossible, to obtain in a group from other circuits. Most important, I suppose, is that no critical adjustments are needed to obtain oscillation; turn it on and it plays. It's adaptable to either series or parallel resonance operation, overtone crystals and performs well up to 75 mc or more. Since the plate circuit is at rf ground, the door is open to any number of special-purpose applications. Another important feature that will appeal to those poor souls who have battled inter-stage feedback is that one side of the crystal is grounded. This reduces stray-capacity effects. The grounded crystal lead enables even more modifications to suit your particular need.

Refer to Fig. 1. C1 and L1 form a parallel resonant circuit at some frequency *lower* than the crystal frequency. This provides the correct phase of reactance to support oscillation. Notice this is opposite of that required for the Miller (tuned-plate) oscillator which requires that the tuned-tank be tuned to a frequency *higher* than the crystal frequency. It all comes out even when you remember that a phase reversal occurs between grid and plate of the tube, but not between grid and cathode.

The actual value of C1 is not particularly critical; between 1 and 2 mmfd per meter will do fine. Remember that there is about 5 mmfd heater-to-cathode capacity built into the average small tube so when C1 and L1 resonate at a lower frequency than your trusty reactance chart would indicate it needn't necessitate a visit to the local head-shrinker.

Maximum feedback will occur when L1 and C1 resonate just below the crystal frequency. Also, here is where they have the strongest pulling effect on crystal frequency. Therefore, be wise and keep them at least ten percent away from the crystal frequency.

Capacitor C2 provides feedback between grid and cathode. At VHF the grid-to-cathode capacity of the tube itself is quite often adequate. The easiest way to find out is to try a couple of micro-micro farads; if the output increases you need it—if not, leave it out. If you like rules of thumb, make C2 two times the square root of the wavelength in meters. This applies throughout the MF-HF spectrum.

The rf path from plate to ground is pro-

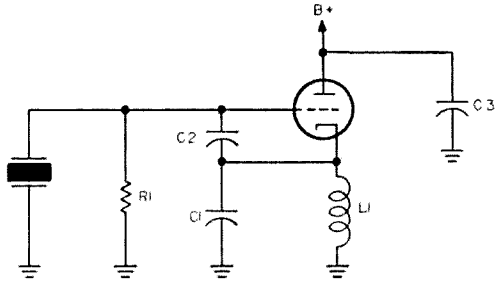


FIG 1

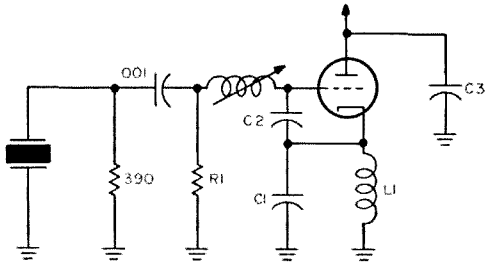


FIG. 2

vided by C3, the least critical component of the bunch. A .01 mfd disc will do nicely through 10 mc. Above that use a .001 mfd disc until you get into the VHF range. 50 mc and higher calls for a good low-inductance mica, 100 mmfd or more.

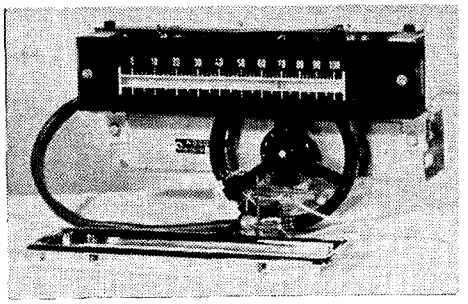
The grid resistor R1 has a moderate effect on power output and, to some extent, harmonic content in the output. If you want to keep harmonics down, keep R1 low in value and, more important, keep the plate voltage as low as possible. On the other hand if you want best efficiency in the circuit (low power drain with best output) a higher value of R1 is called for. In any case it usually will be between 10K and 100K ohms. If you choose a value lower than 22K, put a small rf choke in series with the resistor. This prevents the resistor from becoming an rf shunt across the crystal. Above 22K the choke doesn't buy you anything.

All of the above design rules have been and will continue to be violated for one reason or another, but if you observe them you will be assured of a reliable, trouble-free oscillator that will operate right off the bat.

At this point all our problems are solved except for one minor detail—how to get some output from the rascal. Well, as the fellow says, it all depends. If you are going into a buffer stage tie the buffer grid directly on the oscillator cathode (be sure to provide some cathode bias for the buffer stage). If the oscillator is used to inject a receiver mixer, couple from the oscillator cathode to the mixer grid through a very small capacitor. You can even get low impedance output by lifting the ground lead of C1 and inserting a coax cable in series with C1 to ground. In any event, avoid coupling to the grid since the frequency stability will surely suffer.

Now, with all this groundwork under our belts, let's look into some applications. Right away I hear somebody mention overtone crystals. Easiest thing in the world. All you have to do is set the values of L1 and C1 such that they resonate about 10% lower than the overtone frequency desired. Be sure to check it with your grid-dip meter before you plug the crystal in or turn on the power. The crystal will be operating in the parallel resonance mode with this lash-up. If your crystal is calibrated for series resonance operation and you don't want to put up with the slight frequency shift that occurs when operated parallel resonant, it will cost you three more parts. See Fig. 2. By inserting a small coil between R1 and C2 we now have a form of impedance-

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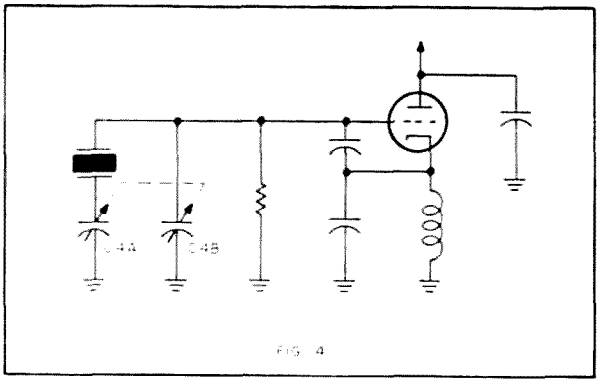
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inversion oscillator. Don't let this scare you—it's quite simple. The Colpitts circuit needs a high impedance between grid and ground. A crystal operating in the series resonance mode is a very low impedance. So the problem boils down to inverting the low crystal impedance to the high impedance the grid is pining away for. If you have delved into transmission lines very much you know that a shorted quarter-wave line will show a high impedance at the far end. If we wanted to coil up a mess of coax line, tying the crystal across one end and the grid on the other we would have ourselves an impedance-inversion oscillator. The little coil between R1 and C2 does the same job, and a heck of a lot neater. It's an artificial quarter wave line. All we have to do is make it the right size. Here's where you need your grid-dip meter again. Most overtone crystals have a capacity of about 10 mmfd measured in the socket. Our little coil must be resonant at the overtone frequency with this capacity. So wind yourself a little slug-turned coil, hook a 10 mmfd capacitor across it and prune it to the desired frequency with the slug somewhere in the middle of its range. After installing it (don't forget to remove the 10 mmfd capacitor) adjust for maximum oscillator output and you're in business series-resonant. The 390 ohm resistor prevents parallel-mode oscillation. The .001 capacitor prevents the grid being shorted by the 390 ohm resistor.



If you are using overtone crystal you're probably a VHF hound and you will be wanting to multiply even higher than the overtone frequency. Go ahead. All you need is a parallel resonant tank tuned to the desired multiple. Insert it between the plate and C3. It looks like a low impedance at the crystal frequency but a goodly amount of harmonic component will appear across it. Sort of a poor man's Tri-tet. Working as a doubler, there's plenty of drive for any of the high-transconductance pentodes (12BY7, 6CL6, etc) working straight through or multiplying. Matter of fact the type 6CX8 tube, triode as an oscil-

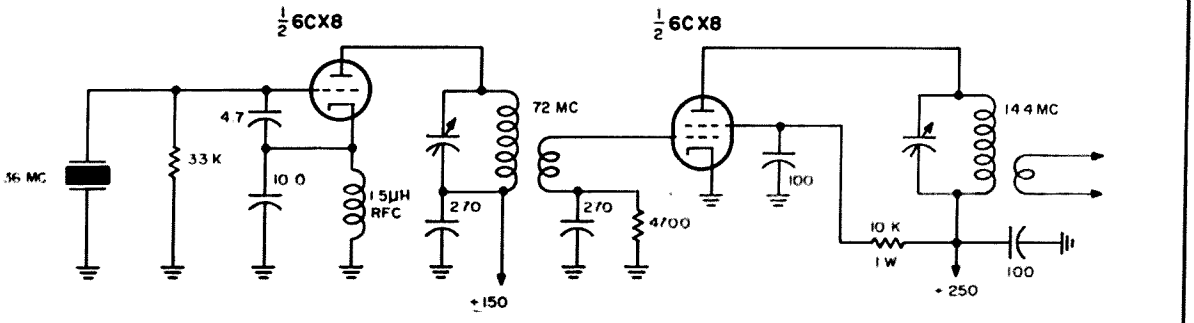


FIG 3

lator-doubler, pentode doubling, will deliver close to a watt at 144 mc with a 36 mc crystal. That's a lot of performance from a single envelope. The circuit is given in Fig. 3.

If you read the crystal oscillator article as carefully as you should have you now know that the crystal frequency can be lowered to some extent by a trimmer capacitor across the crystal, provided that it is operating parallel resonance. (Nothing will move it appreciably in the series resonance mode.) Anyway, to extend this line of scheming, you can just as easily *raise* the frequency from the nominal value by means of a trimmer capacitor in series with the crystal ground lead. By combining the two effects a frequency shift of better than 1 kc per megacycle can be obtained. The big advantage over other methods of rubbering crystals is that no external elements are introduced that will degrade the frequency stability except the trimmers, and they are pretty darned stable in themselves. Also, there is no question as to whether the oscillator is being crystal controlled or not; either the crystal is running the show or there's no show at all. The circuit ends up shown in Fig. 4.

C4 is a two-gang, 100 mmfd per section capacitor of good construction. It must be of the straight line capacity (semi-circular rotor plates) type. Pick one that can be disassembled. The rotor plates must be modified so that they end up quarter-circular. This means cutting them down the center and removing 90 degrees from each plate. The remaining 90-degrees sections on each gang are spaced a quarter circle apart. The object is to end up with both C4a and C4b unmeshed at the high frequency end of the dial, C4a meshed and C4b unmeshed at the middle, and both C4a and C4b meshed at the low end of the dial. The oscillator will usually quit somewhere before you reach the high end but will continue to run to the low end if your crystal is average in activity.

Fig. 5 is another example of modifying the Colpitts to suit a particular requirement. The problem here was to operate a transmitter at the same frequency as the receiver was tuned to. Crystal frequency f2 is the same as the receiver *if*. Frequency f1 is supplied by the receiver local oscillator. The crystal operates in the push-pull version of the Colpitts circuit. Its frequency is far removed from that of the plate tank circuit so that practically no f2 appears in the output. Since the circuit is push-pull, even harmonics of f2 are cancelled. Only the odd harmonics can cause trouble. F1, the local-oscillator signal, is parallel fed to the grids so it gets cancelled in the plate circuit also. In effect, only the sum or addition of f1 and f2 comes boiling through. Does this give you some thoughts for that little portable you've been thinking about?

If you get the idea that I'm sold on the Colpitts, you're right. In applying it over the years, I can recall only one disadvantage over other arrangements. The rf voltage on the cathode has a nasty habit of leaking out on the heater leads. This calls for adequate heater chokes if you need the ultimate in isolation. Other than that, for flexibility, ease of design, and overall reliability, brother, you can't beat the Colpitts. . . . W6LWE

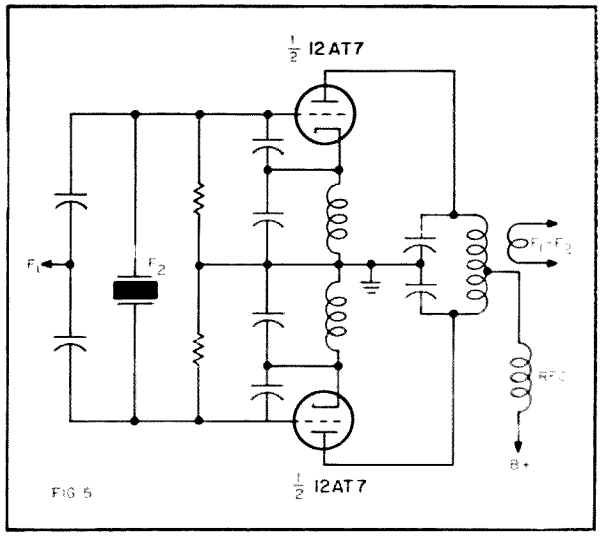


FIG 5

Frank VanBrunt W3TUZ
1003 North Belgrade Road
Silver Spring, Maryland

Of RTTY...

and transistors

MY introduction to RTTY came when I acquired a Model 15 machine, in relatively good working order, albeit, without a cover. A phone call to a local RTTY nut (i.e., a ham who was in deeper, and far more experienced) elicited the information that the device required 60 ma through the selector magnet to operate. While strictly speaking it is indeed true, by itself this constitutes by all odds the understatement of the year! Further information indicated that there were two sections to this magnet and with the sections in series the resistance was about 200 ohms and the required current was 60 ma, or one could connect the sections in parallel (50 ohms) and use 120 ma. Simple calculations thus suggested that either 12 v at 60 ma or 6 v at 120 ma (total power of .72 watts) would do the trick! Alas, would that it were true. It is a longish tale, but read on—travel the road in print with me, and if all goes well, you may be spared some of the trauma I experienced.

The next step was acceptance (with alacrity, I must confess) of his offer of the loan of a terminal unit in first class. A number one shape. The gods were indeed smiling. I drove over and there it was, relay rack panel, 10½" high, and weighing on the order of 60 pounds. All this to use two audio tones to turn this miniscule magnet current off and on. The keying tube was a 6L6, with more than 250 volts for the B supply. Here was almost 6 watts of heater power and over 15 watts of plate power used to deliver the .72 watts to the magnet.

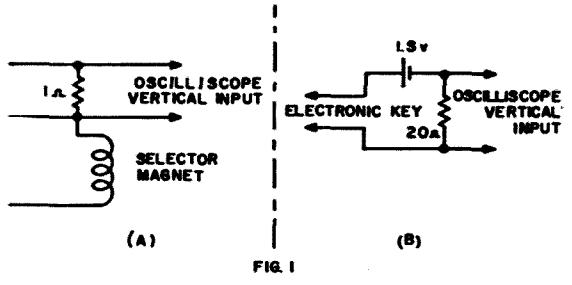


FIG. 1

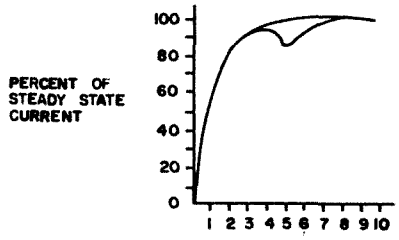
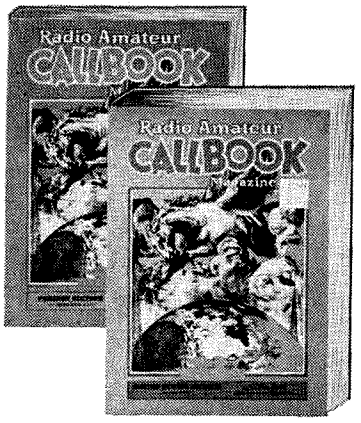


FIG 2

Somehow, this reminded me of the lad who used a steamshovel to transplant petunias! But there is an old saw regarding gift horses and teeth, so off I went, staggering under the load. I got it home, hooked it up and it worked, and well, indeed, but I could not escape the feeling that there should be an easier way to do the job.

The obvious approach was to use transistors. As current operated devices, they should indeed be fine for switching the magnet current off and on. In other portions of the circuit they should be equally good. The highest frequency in the unit was 2975 cps and most of the circuitry would be dealing with 22 millisecond pulses—certainly no fancy transistors would be needed for those frequencies. So the Mark I transistor terminal unit was built, by merely substituting a transistor stage for each tube stage in the circuit (which as a general propo-



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sition is the easiest but not the best way to design equipment). It worked, but the performance was less than sparkling. The next step was to design a unit following a block diagram of the functions desired; the result was a complete FSK unit using only three transistors. It worked better, and in fact, a fair number of copies of this unit have been built. It performed fairly—but, to be candid, not as well as the tube unit. The feeling persisted, however, that it should be feasible to build a transistor unit that would perform as well as the tube unit, and do it in a simpler, more compact, and more efficient manner.

An article in RTTY NEWS put me on the right road. There was a discussion and illustrations of the current rise shape in the magnet produced by a terminal unit. We promptly hooked up a scope to monitor the current and fed in 22 millisecond pulses. This is easily accomplished, just put a 1 ohm resistor in series with the selector magnet of the machine and connect the scope input across this resistor; the voltage across the resistor will be a function of the current through the selector magnet and the extra resistance will have a negligible effect on the operation. (See Fig. 1A). One word of caution, a dc scope is an absolute necessity—the frequencies involved are low enough so that practically all ac coupled scopes will distort the wave shape. If there is any question in your mind on this point, use a relay, a battery and a resistor—key the relay at the pulse rate, connect the scope across the resistor, and observe the wave shape—if it isn't square, it is the fault of the scope. (See Fig. IB). Incidentally, if you have an electronic key, it's a fine square wave generator; just set it for dots at about 22 or 23 dots per second and you are in business. Alternatively, 4 or 6 volts ac into a polar relay will do the job.

There ensued a number of evenings looking at traces which were intended to be square waves, and missed the mark in varying degrees. The root of the problem is the selector magnet. We are applying a voltage to a device which consists of a resistance and an inductance. If the inductance is fixed, you get the smooth curve in Fig. 2. However, the inductance in a teleprinter is not a fixed value. When the armature is not against the pole piece, the inductance is about 2 henries; when current is applied, the magnet charges, and as the field increases, the armature is drawn in. The physical movement of the armature is accompanied by an increase in the inductance. For purposes of analysis, this is convenient, since this change in inductance causes a jog in the current curve, and gives a visual indication on the scope of the point at which the mechanical transfer from mark to space occurs (See Fig. 2). All the wave shapes here have a time base on the horizontal axis and selector magnet current on the vertical axis.

As a starting point, consider the basic land line printer circuit for the Model 15, with a supply voltage of 120 volts, selector magnet sections series connected, and a resistance of approximately 1800 ohms to limit the current to 60 ma. The time constant of the circuit in milliseconds is the inductance in henries divided by the resistance in ohms (the limiting resistance plus the resistance of the selector magnet). In this case the time constant is 1 millisecond, which means that in 1 millisecond the current will rise to 63 per cent of its steady state value, in 2 milliseconds it will rise to 86 per cent of its steady state value, and in 3 milliseconds it will rise to 95 per cent. By using even higher voltage we can increase the series and thus achieve a still shorter time constant, however, we have a mechanical motion of the armature involved and beyond a certain point, an even shorter electrical time constant will not give significantly faster mechanical movement. Hence, any efforts in this case will result only in an

increase in power consumption without any corresponding gain in performance.

What happens mechanically under these conditions is that there is a delay of about 3 milliseconds between the closing of the circuit and the mechanical transfer, and at the end of the pulse, if the spring tension is properly adjusted, there is also a 3 millisecond delay in the return to the resting position. This adjustment gives the maximum range for the machine. The effects of less than optimum magnet currents are obvious from the family of curves in Fig. 3. At lower current levels the delay in the mechanical transfer becomes progressively longer and the action slower—and, in fact, it is possible to have a current level such that the delay equals the pulse length! The result is that the range of the machine becomes progressively smaller and the operation correspondingly less reliable. It might be noted that for the relatively slight decreases, it is possible to adjust the spring tension, and thus the delay or drop out to compensate for the increased initial delay. However, for optimum performance, it is far better to accept the manufacturer's word on the optimum eurrent value.

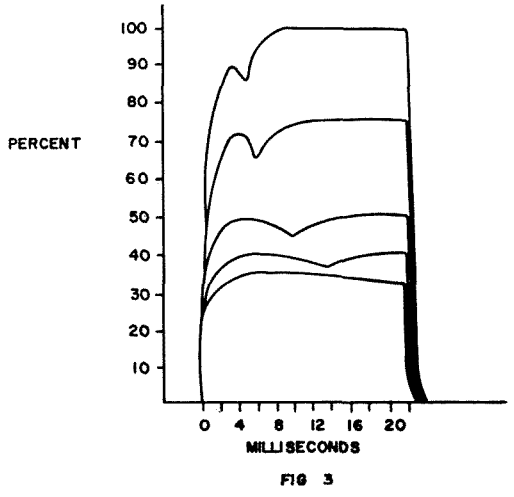


FIG 3

With regard to this process of lengthening the drop out time to compensate for slow rise time, we ran across an interesting commercial application. One of the commercial units that is marketed as a solid state replacement for the polar relay was tested and gave the current wave shape pictured in Fig. 4. The rise time is slow but the circuit has been designed to give a correspondingly slow fall time. The result is that the range of the machine remains about the same. With a machine which is not properly adjusted, this might even increase the range. In on the air tests this was more sensitive to interference and gave poorer performance than either the best tube units or the transistor circuit we eventually used.

In a typical electron tube terminal unit that provides magnet current through a keying tube, we normally have 250 volts or more and a tube such as a 6L6 or 6Y6, which can handle the current satisfactorily. The variable series resistance and the plate resistance perform the current limiting function. The time constant is even shorter than that of the manufacturer's recommended circuit, and if properly driven by a square wave input, the performance is indeed good. A tube having a sufficiently high perveance should perform well with a 120 volt supply, although no tests have been made on such units.



FIG 4

Next, consider the case of a transistor. If we merely replace the switch or relay in the conventional keying circuit with a transistor, the performance should be practically the same as the manufacturer's recommended circuit. The transistor, having a far lower saturation resistance than a tube should do better than a tube. If you start pricing transistors that will operate comfortably at 120 volts, you immediately conclude that theory and pocketbook don't always agree. In addition, the other transistors in the unit don't need voltages of this order, so you would either have large dropping resistors or need two separate power supplies—neither alternative is particularly appealing.

An example of this approach has been published which uses a grounded base high voltage transistor (this helps on the voltage capability side, but makes driving the device far more difficult) and requires three different power sources. Another effort to beat the rap has been published which uses three 45 volt transistors in a complex series arrangement. Neither of these alternatives are particularly attractive. The next step you might try (we did) is to see what will happen with a pedes-

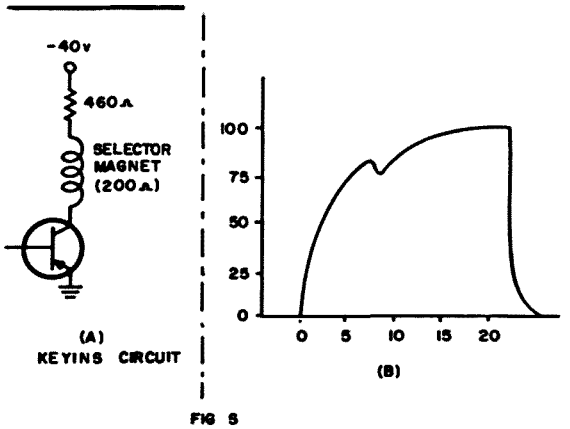


FIG 5

trian transistor and a 40 volt supply. The discouraging results are reported in Fig. 5. This will give copy, but it will not give good range or compete with the better tube terminal units.

The next step along the path was ridiculously simple. If we use 60 ma through each section of the magnet for satisfactory operation, we can do it with 60 ma and the sections in series, or 120 ma and the sections in parallel. Now when we put the sections in parallel, we have .5 inductance rather than 2 henries. Consequently, with 60 volts at 120 ma we have the same time constant and the same performance that we had with 120 volts and 60 ma. The increased current is easily handled by a transistor, whereas a tube to do this would be a fairly substantial bottle! At this point we were on the way, we'd cut the voltage requirement by a factor of two, but 60 volts was still too high for convenience i.e., a reasonably priced transistor. We really wanted something that would operate in the 30 to 40 volt region (with a bridge rectifier circuit and 15 to 20 volts available for the signal processing circuitry) and would yield all the performance of which the complex machinery was capable.

The next step was a closer look at the basic keying circuit. (Fig. 5A). This was not really what was desired. Better performance would be possible if the resistance could be made a direct short while the magnet was charging, and when the current reached the desired level, the resistance increased in value to that necessary to limit the current. It not only had to do this, but should be sufficiently fast acting so that an added time constant is not superimposed on the one we are struggling to reduce. While we did not come up with a device that would shift from zero resistance to the desired value, we did indeed find a solution that approaches this desired end!

This solution is a current limiting circuit which uses a transistor, a zener diode, and two resistors. (Fig. 6). In this circuit R_2 is chosen so that the voltage drop across it with full operating current is equal to the zener voltage of D_1. For a 3.5 volt zener diode this required a 30 ohm resistor. When the current is less than the required current, transistor Q_1 is in effect a very low resistance; when the current reaches the desired value, the effective transistor resistance increases and the voltage drop across the transistor increases to that necessary to maintain the desired voltage.

If we compute the time constant, it would appear paradoxically that we have increased it—but the computed time constant would be that which is required to reach a steady state value limited only by R_2 plus the resistance of the selector magnet. This current is about 500 ma and what concerns us is only the first 24 per cent of this value. In actual practice the rise time is quite fast. The actual measurement was 2 milliseconds to reach 90 percent of the final value. This is faster than the computed values for the recommended 120 v, 60 ma condition, which are 63 per cent in 1 millisecond and 85 per cent in 2 milliseconds. The measured rise time for an ex-

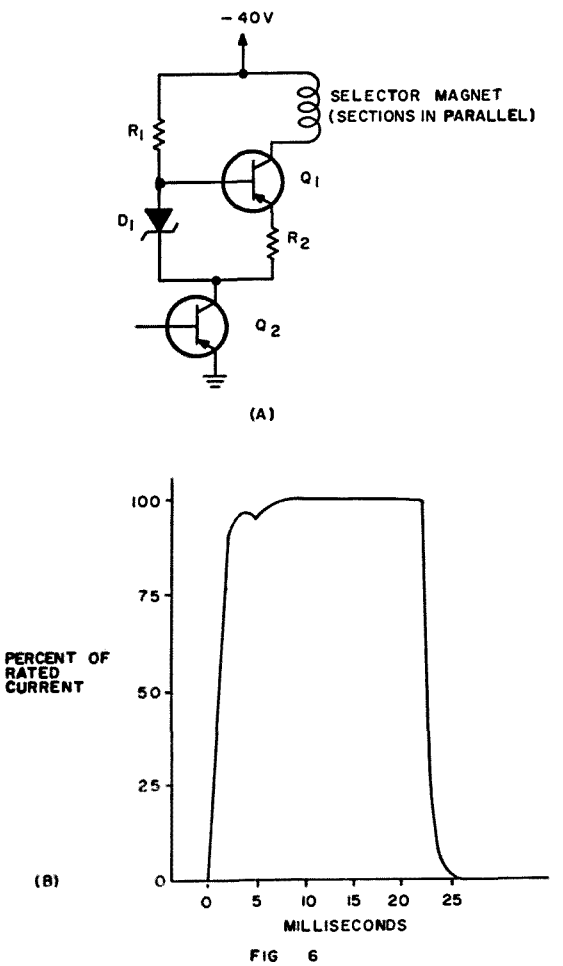


FIG 6

cellent tube terminal unit was 87 per cent in 2 milliseconds—also better than that of the suggested circuit. The resulting current rise curve is given in Fig. 6B.

This then was the performance we were looking for—a circuit using transistors, operating at a reasonable supply voltage, and giving performance equal or better than the manufacturer's suggested circuit, and the best tube units. This circuit, using two transistors, requires less total power than that needed to light the filament of a 6L6. The final result was incorporated in a terminal unit a small fraction of the size of the original rack mounted monster, which performs fully as well, but that is another tale for another day.

A word of caution should be added on the usual practice of patching in an extra machine by the simple expediency of putting the second printer in series with the first. It is convenient and usually only requires an adjustment of the series resistance to bring the magnet current up to normal value. However, a moment's thought and it is obvious that this doubles the inductance of the circuit—and doubles the time constant. The wave form only confirms the sad news, it takes twice as long to reach a given current level and performance suffers. This can be avoided by placing the printers in parallel instead of series; in this case the time constant remains the same and the performance is not degraded. This is not done with tube units because the tubes are normally working at nearly maximum current. With transistors current is no problem and such operation is easily accomplished. In the circuit in Fig. 6 the only change necessary is the value of R_2. If separate magnet current control is desired, a duplicate of the circuit with a common Q_2 switching transistor would do the job nicely without degrading performance.

Nothing has been mentioned thus far about fall time. In actual practice this does not constitute a problem. In practically all units, both tube and transistor, the current was down to an insignificant level in 2 milliseconds or less. In no case were voltage spikes observed on any of the waveforms observed. One case where a slow fall was observed was during the testing of various transistors in the circuit of Fig. 5. Transistors ranging from 300 mw up to high power 15 amp. varieties were tested and almost all performed nicely. Even high power units such as 2N174's and 2N277's worked well. The only failure was an archaic 25 amp. unit which took about 6 milliseconds to fall to the 10 per cent level.

With regard to this process of lengthening the drop out time to compensate for slow rise time, we ran across an interesting case. As for practical values, if you want to give it a try R_1 is 5K or 10K. R_2 in practice is either trimmed to the precise value to give the desired current and left alone—or if like most of us you have an insatiable desire for knobs, use a 50 ohm potentiometer in series with a fixed 22 ohm limiting resistor. The diode should be a low voltage zener on the order of 3 or 4 volts. Those used have been 1N703 or 1N466. Theoretically, the lower the voltage the better, but 6 and 7 volt units have been tried and performed nicely. For transistors try a 2N251, 2N538 or any 40 or 50 volt unit, the higher the beta, the better.

. . . W3TUZ

Letter

Dear Wayne:

Not long ago you autographed #17 of the bound volumes covering the first fifteen issues for me. If this act had not been akin to lighting a slow fuze on a keg of black powder, I wouldn't be writing you now.

I am new to ham pleasures, Novice March '61—Tech—July and General in October. I have subscribed to Brand X for several years. Brand Y for a year or so, as well as several of the others in electronics generally. I had heard of 73 vaguely but hadn't seen it until about 3 or 4 weeks ago at a local informal gathering when I had a chance to get my hands on the March issue. I made appropriate notes and you subsequently received my subscription, and as I like to keep things neat and tidy, an order for January and February so my file would start at the first of the year.

I don't know just when I began to realize how new 73 was and that for $14.98 plus 2¢ postage I could really tidy things up and go back to the very beginning, but it must have crept in sometime.

Anyway I eventually found time to do more than peruse the January and February issues and directly started hunting for fifteen clams. Such a magazine never grows old and if all fifteen issues compared at all with the two I had in hand at that time, have them I must.

You know the rest from the checks you have read, etc. and in due course the bound volume arrived.

To date I've been mostly a kit builder but have always looked forward to going home brew and would, if necessary, discount a little quality for the fun. So your viewpoint is refreshing to say the least.

Can you guess dear editor what happened next? Do you and the others who have looked on 73 as individual copies of a monthly magazine, who have sipped its nectar in delight, have any idea what an orgy of fifteen copies all at one time can do to a guy?

I have problems. A 2 meter converter. What would the Finney 6 & 2 antenna really do? etc. etc. Now I only have one problem after I sober up, and that is where the heck do I begin?

You can quote me on this, Wayne, the fifteen for that bound volume buck for buck ranks with any I've ever spent. All late comers should be so advised.

Jack Morgan, K1RHP
Sharon, Mass.

The Crystal Ball

Jim Kyle K5JKX

OCCASIONALLY, a multiple-purpose gadget comes along with specifications that sound like an ancient ad for patent medicines. You know, the kind that grow hair on bald heads, cure colds, remove warts, and relieve insomnia.

Here's one of those kind of gadgets; containing only one crystal diode, two capacitors, a meter, and miscellaneous wire and sockets, this device will:

Measure activity of transmitter crystals, both at the fundamental and at all usable overtone frequencies;

Compare crystal frequencies, as in selection of crystals for sideband filter use;

Mark any number of spot frequencies when connected to the output of a VFO-equipped transmitter, acting as a marker at both band edges and at any number of frequencies within the band; and

Determine usability of an individual crystal at a specified overtone.

The circuit of the gadget is shown in Fig. 1. You can see that it consists, essentially, of a sensitive rf voltmeter made up of the diode, two capacitors, and meter, in series with a crystal socket and an rf signal generator.

When a crystal is placed in the socket, incoming rf from the signal generator must pass through the crystal to reach the voltmeter. This can happen only at a series-resonant frequency for the crystal concerned; the amount of rf which gets through is proportional to the individual crystal's activity.

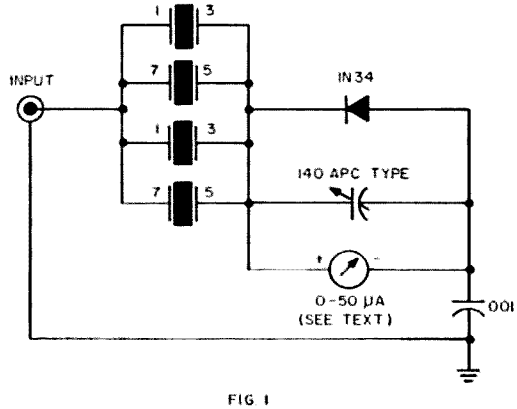


FIG 1

Thus, the meter will indicate upscale only when the input frequency is the same as one of the crystal's series resonances, and the amount of upscale deflection will indicate crystal activity (the greater the deflection, the higher the activity).

That's how it works, but to use it in all the ways listed earlier the basic connections must be changed slightly. We'll go into that, but first, let's look at construction details.

For maximum convenience, the "Crystal Ball" should be housed in a small minibox; the "input" connection shown on the schematic should consist of a coax connector, for either a coax jumper or a small loop of wire (for coupling to a grid-dip meter to serve as a signal generator).

To hold expense to a minimum, you can use one *octal* and one *loctal* base wafer sockets (approximately 10¢ each) as the crystal sockets. Connect pins 1 and 7 of each socket together (pin 1 of octal to pin 7 of octal, thence to pin 1 of loctal, and then to pin 7 of loctal) and pins 3 and 5 of both sockets together in the same manner. Thus, two FT-243-type crystals may be inserted in the octal socket at the same time, and two of the newer small-pin crystals may be placed in the loctal socket. If you need more crystals than this (for frequency spotting), use two or three of whichever type socket you need, connecting them all the same way.

Sensitivity of the entire device is determined by the meter. A 50-microamp unit is recommended (Lafayette Radio sells a 50-microamp "tuning meter" which has no calibrations, for $2.95. This works admirably in this circuit) but you can get by with a 100-microamp unit if you must.

Naturally, shielding of the entire circuit is essential to confine all stray rf. This is particularly important if you're using it as a frequency spotter.

Now, let's look at the four main uses of the Crystal Ball:

To measure crystal activity, connect a signal generator such as the Heath SG-8 to the input

connector. Plug in the crystal you want to measure. Tune the signal generator slowly until the needle peaks (this peak is extremely rapid; you may miss it if you tune rapidly). When the needle peaks, the deflection is proportional to crystal activity. If the needle goes offscale, reduce capacity of the variable capacitor. Now, you can compare the activity of this crystal with others by substituting the other crystals and noting whether their peaks are greater or lesser.

To measure activity at an overtone, follow the same procedure. If one crystal's activity is measured at several overtones, you can select the overtone at which the unit gives greatest output (but signal-generator output should be reasonably uniform over the frequency range used for results at widely separated frequencies to be comparable).

To compare crystal frequencies, the same procedure is followed except that a calibrated receiver should be used to measure exact frequency of the peak of each crystal unless the signal generator calibration is extremely accurate.

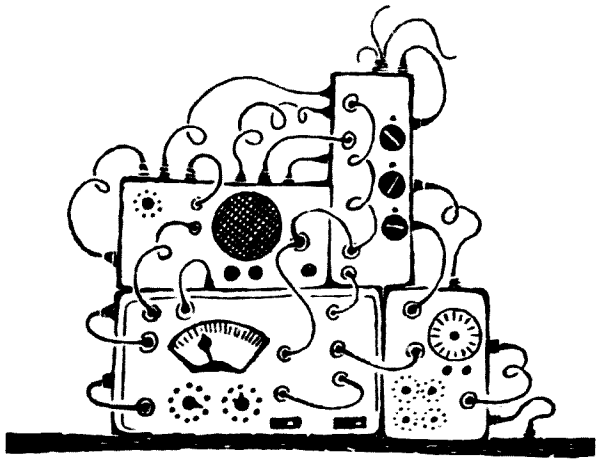
To use the Crystal Ball as a frequency spotter, disconnect the signal generator. Connect a tee fitting to your transmitter's antenna connector, and connect a coax jumper from this fitting to the input connector of the Crystal Ball. If you're running more than about 50 watts power, it's best to insert a 50-mmfd capacitor in series with this line (place the capacitor in a shielded box, with the box located in the center of the jumper) to protect the marker crystals from excessive rf voltage. Plug "marker" crystals of the frequencies you want to spot into the gadget. Whenever the transmitter is tuned to one of these frequencies, the meter will deflect upscale. The VFO dial will tell you which of the marker spots you're at, unless you pick two so close together than calibration of the dial is uncertain.

Finally, to determine usability of a crystal at a specified overtone, go back to the activity-measuring setup. Set the signal generator to the approximate overtone frequency desired and "rock" the generator dial until you see a meter indication. If you get a good, healthy upswing, the crystal is usable at that overtone; if the upswing is weak or missing, the crystal won't work at that particular overtone. However, this does not mean that the same crystal won't work at *other* overtones, either lower or higher. Frequently, crystals perform nicely at high overtones when they won't work at all at lower ones.

The basic idea behind this gadget, incidentally, is probably almost as old as the quartz crystal itself; a variant, using a magic-eye tube instead of a meter, was used in all the WW2 Command-Set transmitters as a calibration technique. However, like many old ideas, it's worth repeating. . . . K5JKX

WATERS UNNETTLES RIGS

COAXIAL SWITCHES

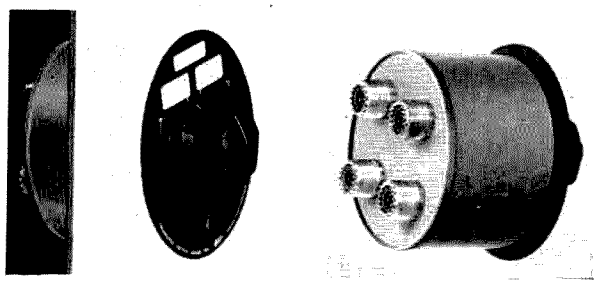


SWITCH IN, SWITCH OUT, OR DO THE 6-WAY SWITCH IF YOU'RE A HAM WHAT AM WITH A WATERS COAXIAL SWITCH.

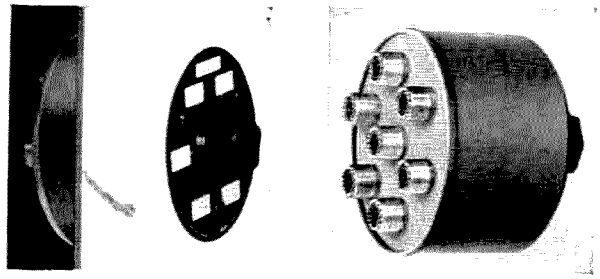
Designed for panel mounting, and featuring in-line orientation of the coaxial connectors, these compact units occupy a minimum amount of space with ready access for connecting and disconnecting. The Waters Coaxial Switches have a negligible insertion loss, low standing-wave ratios (less than 1.1 up to 150 mc.), and a power carrying capacity of 1 kw. They come in two models complete with mounting screws, knob, and escutcheon plate with provision for erasable markings.

COAXIAL TRANSFER SWITCH — MODEL 336. A double-pole, double-throw (internally strapped) unit for in-and-out switching of a Power Amplifier between an exciter and antenna. Connections are made to 4 standard SO-239 UHF connectors. Amateur Net: $11.45

COAXIAL SELECTOR SWITCH — MODEL 335. A single-pole, 6-position switch used for selection of RF sources, antennas, etc. Connections are made to 7 standard SO-239 UHF connectors. Amateur Net: $12.95 . . . . . Available at leading distributors

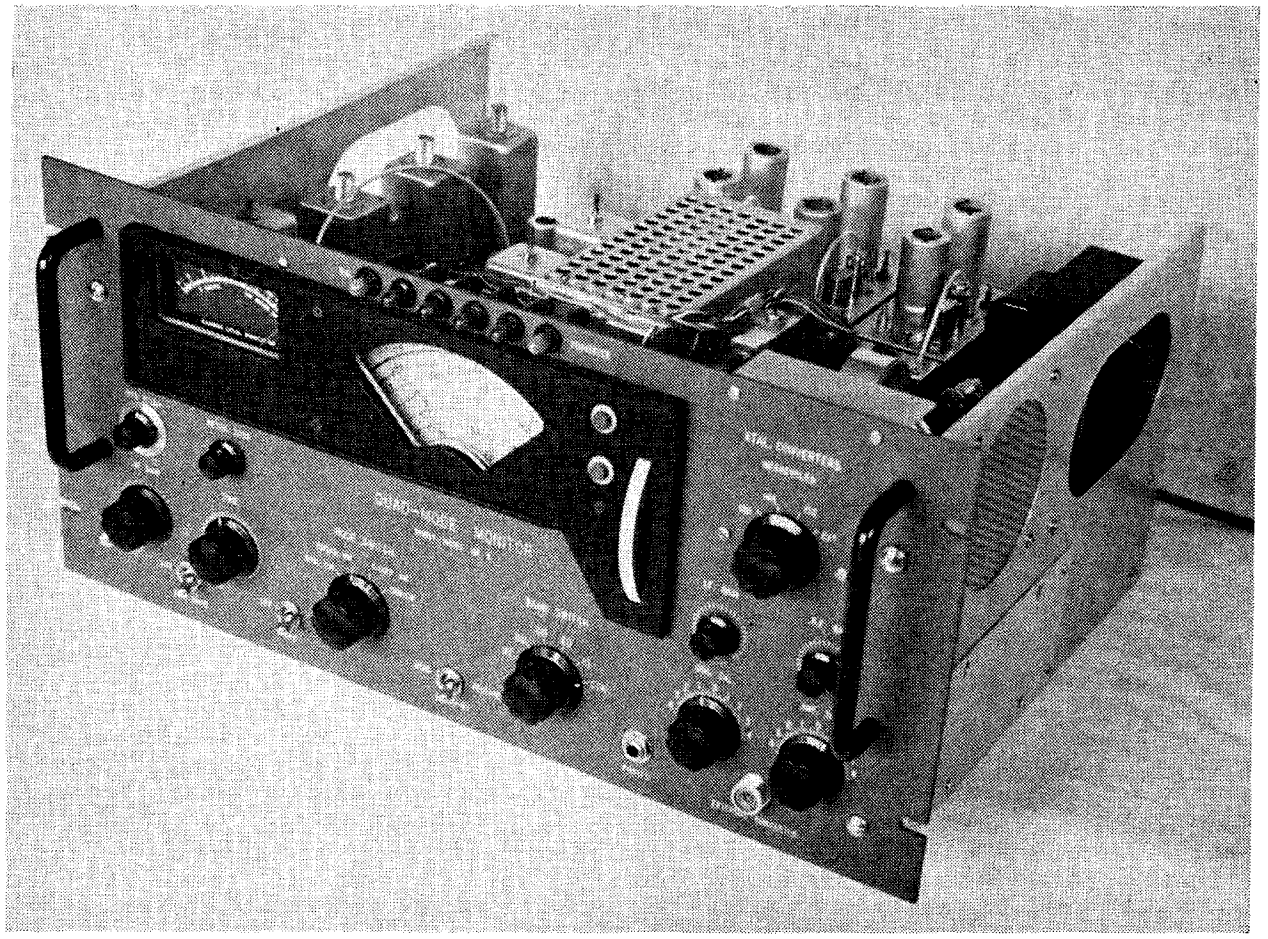


COAXIAL TRANSFER SWITCH — MODEL 336



COAXIAL SELECTOR SWITCH — MODEL 335

WATERS MANUFACTURING, INC.
WAYLAND, MASSACHUSETTS



Angle View showing location of built-in speaker, and the access to the rf coils which is covered by the small plate just below the speaker. Reference made to this effect in the manuscript.

Quad Mode Monitor

John Wonsowicz W9DUT
4227 North Oride Avenue
Norridge 34, Illinois

Interested readers at one time or another undoubtedly have had the pleasure of investigating some fine commercial communication receivers, or even some unusual home-brew design squawk boxes with features that were quite appetizing to an average ham. Perhaps some of these features were so good that the desire of owning such a hearing-aid was so strong that it required all the will power one could muster to be torn away from not mortgaging the family car and purchasing the beaut. Well, if you're among those reaching for the finest, with disregard for the sweat of your brow and the imposition on your bank account, here is your chance to be the proud owner of such a unit. Of course you must have determination and perseverance to follow through, because this project requires more time than the usual converter or a small transmitter; but once finished, you can relax and enjoy the pleasures of your masterpiece for years to come.

In summarizing the advanced and exclusive features of this "Quad-Mode Monitor" as it is called for the four modes of reception, the goodies incorporated there-in are as follows: Modular construction, motor tuning, reception of NB FM, broad AM, sharp AM, upper and lower SSB, and CW, built-in VHF xtal converters, built-in auxiliary speaker, wide range of frequencies, large illuminated translucent dial, big illuminated S meter, tone control *if* gain control, rf gain control, etc., all this and more built on a standard 3" x 17" x 13"

aluminum chassis with a standard 8¾" x 19" relay rack panel.

In design and construction of this receiver, no compromise had been made in material or workmanship to achieve the utmost in performance and pleasing professional appearance; so only the finest quality of coils, *if* transformers and ceramic coil forms were used as specified in the parts list or indicated in the schematic, and these were obtained from J. W. Miller Co.

To lessen the difficulty in construction of such a project, standard parts were used as much as possible. However, needless to say that a project of this kind requires a number of specialties that must be pieced together and fit into their respective niche, so many parts had to be machined. Fortunately, my access to a fine machine shop made this project materialize without imposing on my friends, and was completed in a record time of 8 months.

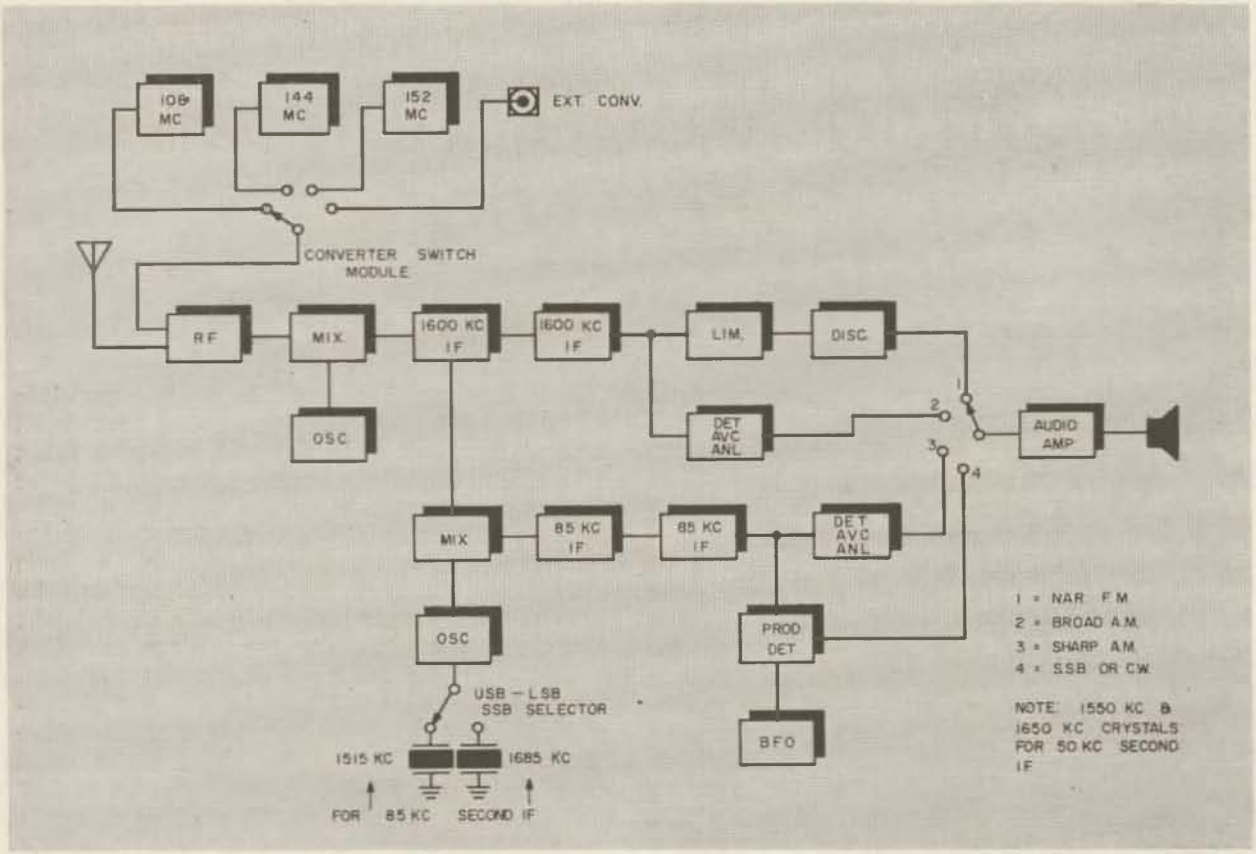
Mechanical

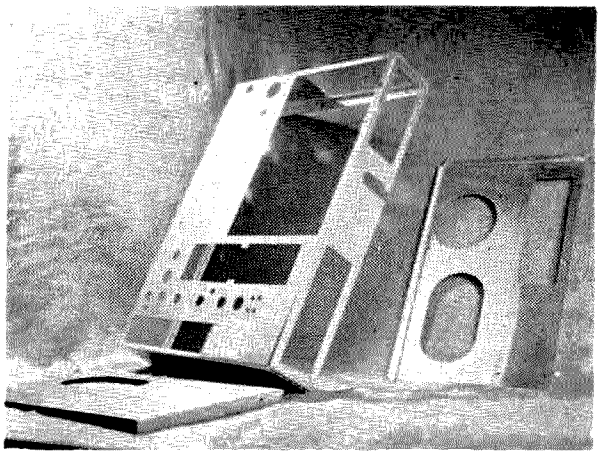
It is surprising to say the least that commercial receiver manufacturers haven't latched on to the very handy way of building ham receivers, which is the module construction as seen in the photo. This type of fabrication is not only simple, convenient and more economical, but also uniform; for each module when completed mechanically can be phased and optimized on the bench before securing it in place. Such construction was used in this receiver and modules developed are as follows:

Complete front-end with all coils, tuning capacitor, band switch and motor drive.
25 volt dc power supply for the drive motor.
High frequency (1600 kc) *if* strip.
Low frequency (85 kc) *if* strip.
Beat frequency oscillator (85 kc).
Converter switch.
Xtal controlled converters, and
Converter plug-in assembly with power receptacles.

To begin with, the main aluminum chassis was modified by the cut-outs for some of the above mentioned modules and the side brackets were bent on a hand brake and fastened to this chassis by 4-40 machine screws, as shown on the photo.

The right hand side of the aluminum bracket houses a 4" PM speaker as indicated by the round speaker grill near the front panel. Under the speaker is an opening for access to the rf coils. This is covered with a 3" x 6" aluminum plate. The far side of both brackets have oval hole cut-outs to substitute for carrying handles. Rectangle design of brackets instead of the usual triangle type shown in most catalogues were used for ease of handling and the ability of setting the receiver up-side down when working on the underside of the chassis, thus eliminating possible damage to components mounted on top. The dial escutcheon was machined from a piece of 5" x 11" x ¼" aluminum plate with the back side milled out for a ⅛" plexiglass window for the dial. Around this plate a rectangular bar of aluminum ½" x ⅛" was secured with flat head 2-56 machine





Main Chassis. Standard 3" x 13" x 17" aluminum chassis showing cut-outs for modules and front panel mounted controls.

Aluminum side brackets 8" x 13" with exposed ends bent for stiffening.

screws to form a pleasing three sided frame. After the cut-outs were made for the dial and the S meter, the assembly was sprayed with black crackle varnish to give it a professional look and to match the rest of the trim.

Front panel of this receiver required some study for the controls had to favor the best wiring practice and at the same time look neat and professional like; but after a few sketches and a little study, the design was frozen and all controls were fitted onto a 8¾" x 19" standard relay rack panel which is crackle gray aluminum. All associated dials were matched and nomenclature engraved.

The six lights above the escutcheon plate are used to indicate the band in use and are switched in with the band switch. They are miniature neon panel lites and operate from 110 volt ac through a 10K-½W isolation resistor. Black aluminum handles were provided for ease of removal from the cabinet, also to protect the dials from damage if the receiver is ever placed on it's face.

Electrical

Before going into details of circuitry and placement of components let's look briefly into the outstanding features of this receiver. Actually, this hearing-aid was designed for highest sensitivity possible, contrary to some engineers belief that sensitivity below .5 micro-volts is stretching it too far and is only good for noise reception. This may be quite true in some noisy locations and especially if such high sensitivity cannot be controlled. However, in this unit which has a usable sensitivity of .1 micro-volt and better on band 4 and below, and .2 micro-volt on band 5, it is controlled by the incorporated rf and *if* gain controls brought out to the front panel that can be varied to suit every condition.

Looking down the home stretch, this receiver is a double conversion super on all bands up to 30 mc if so desired and operated in the sharp AM or SSB mode. It becomes a triple

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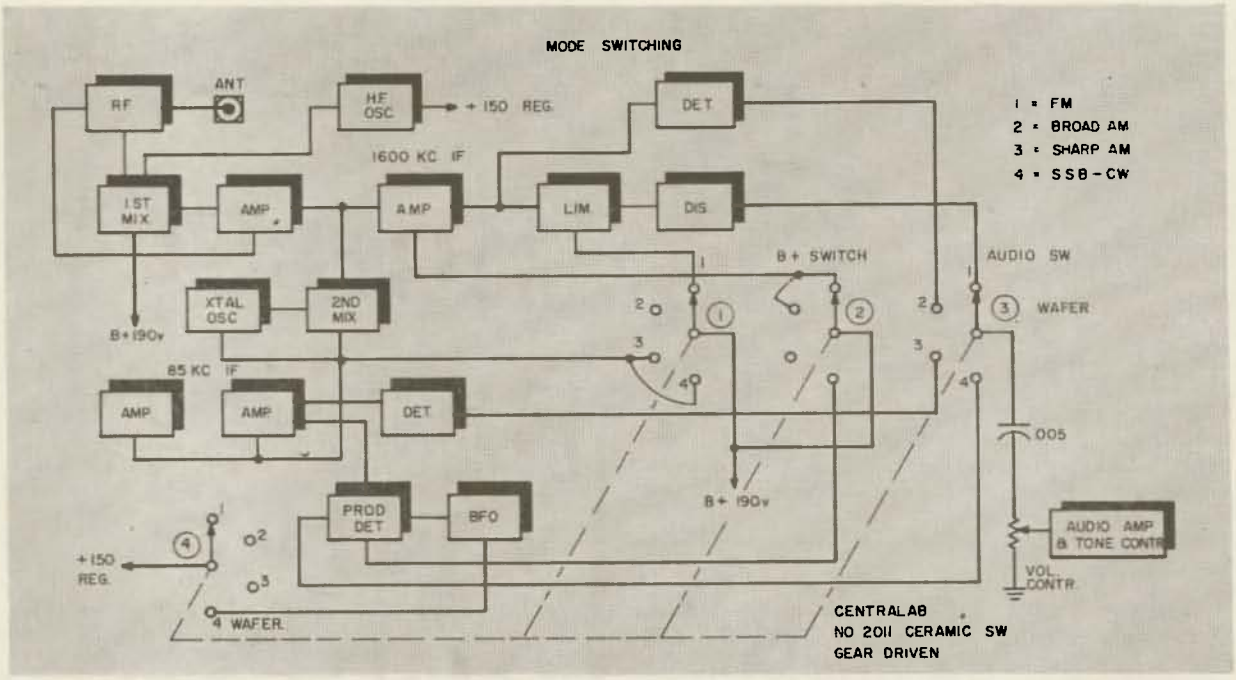
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conversion device when used with the built in xtal converters, or a single conversion type when used in the broad AM or FM mode.

First *if* Amplifier

The selection of intermediate frequency depends on factors such as good image rejection and selectivity. But don't overlook the fact that powerful commercial stations near-by may feed into the wiring of a high gain amplifier completely ignoring the path of the front end. For this reason it is worth the effort to familiarize oneself with the bothersome local stations and select an *if* frequency at least 100 kc away. Of course a high intermediate frequency only gives good image rejection but poor selectivity, so one must resort to dual conversion and choose a second *if* that will suffice in separating the stations in the now congested bands. Usually a 50 kc up to 262 kc is good second conversion, depending on how much selectivity one needs for his particular operation. For high frequency AM and SSB, the lower the frequency the better, but for VHF operating using xtal converters, too much selectivity can be detrimental due to unknowingly passing stations while tuning.

After due consideration, the first *if* was selected as 1600 kc and the first *if* module built consists of two stages as amplifiers, one stage as a limiter and one stage as the FM discriminator. In the broad AM position the selectivity of this receiver is in order of 10 kc at 6 db down.

Front End

A lot of consideration must be given to the "front end" since that is the head of the table; a mediocre choice in design may hamper the overall performance of the completed unit. Many books were written on why's and why not's, peaks and pitfalls of tubes and circuitry involving rf amplifiers, mixers and oscillators, but if you're like I am the more you read the stuff the more confused you get. The surest way out of the dilemma (assuming that you have a good signal generator and a VTVM) is the soldering iron and a hand full of parts together with some notes on progress made. From these notes as an embryo the front-end module took shape and consists of a 6AK5 rf amplifier, 6BE6 mixer with separate injection using a 6C4 triode as a Hartley HF tunable oscillator operated with 150 volts on the plate from a VR 150 volt regulator.

The image rejection of this front end measured through the first *if* is better than 60 db; being comparable to the finest in communication receivers. Frequency coverage of this front end are as follows:

Band 1—500 kc to 800 kc
Band 2—2.8 mc to 5.7 mc
Band 3—5.7 mc to 10.4 mc
Band 4—10.4 mc to 18.4 mc
Band 5—18.4 mc to 30.0 mc
Band 6—switches band 4 into converter position and grounds the antenna input to band 4 to prevent signals from beating with the converter. This will be explained later in the article.

Second *if* Amplifier

Upon completion of the front end unit, the low frequency *if* strip came up for consideration. This module was viewed from the point of selectivity and question of frequency selection was obvious since an old surplus receiver using fine 85 kc intermediate frequency transformers was on hand. The old transformers were removed, taken apart, cleaned and reassembled and three of these transformers with two 6BA6 pentodes are used in this module. To keep excessive gain down to a reasonable level, this strip is operated at re-

duced voltage. The overall selectivity of this strip is 2 kc at 6 db down. Being quite satisfactory for reception of AM and SSB.

Xtal Converters

In as much as this is a complete package embodying everything including the proverbial kitchen sink, the converters had to be included; and since they became part of the main chassis, a switch had to be designed for ease of control. The switch module incorporates the switch and miniature coax connectors to select any of the three converters, or the coax connector on the front panel for an external converter with an *if* frequency of 10 to 18 mc. Converters with *if* frequency of 3 to 30 mc can be fed into the antenna coax connector on the back of the chassis.

Frequency coverage of the built-in xtal converters is calibrated on the main dial and is as follows:

No. 1—107 mc to 109 mc
No. 2—143 mc to 148 mc
No. 3—152 mc to 157 mc

Detectors

Since it was a simple matter in wiring detectors, space was provided for them on the main chassis so that each of the four detectors was close to their *if* strip and the audio amplifier.

The detectors are as follows: FM discriminator, 1600 kc AM detector with built-in ANL, the 85 kc AM detector also with built-in ANL and a product detector for SSB and CW with separate BFO injection.

BFO

The beat frequency oscillator is a module built on a 2¾" x 2⅛" x 1⅝" mini-box and uses a Miller 50 kc modified transformer with a 6C4 triode connected in a Hartley circuit. Cathode output is used which is brought out to a miniature coax connector.

Xtal Oscillators

Good communication receivers of today are selectable sideband receptors, and since this unit falls into that category, two crystal oscillators are used in the conversion to the low frequency *if* for the selection of upper or lower sideband. These oscillators are controlled from the front panel by a single pole double toggle switch.

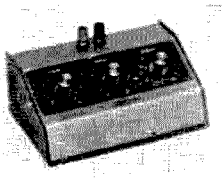
Tone Control

A phenolic strip with all necessary components constitute the tone assembly. A pot, being the variable tone control is mounted on the front panel and wired with miniature coax cable to the phenolic tone assembly. This simple but worth while device adds pleasing tone quality when listening in the broad AM or FM mode.

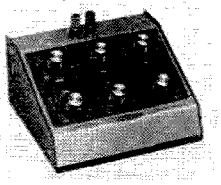
Other controls brought out to the front panel are, antenna trimmer, BFO pitch, osc. calibrate, meter zero, stand-by switch, and of course the main tuning. The main tuning is operated by thumb action for vernier tuning or by the push buttons mounted in the escutcheon for rapid excursions with motor drive. Tuning ratio through the worm drive is 50 to 1, making motor tuning very desirable.

Next month we'll have complete information on the construction of this receiver.

. . . W9DUT



Decades



Anyone who has done much experimental work has felt the need of a good resistance or capacity decade. Many of us have gone to the trouble to build up our own since the commercial models heretofore have been rather expensive. Heath has done it again with their new IN-11 and IN-12 decade boxes which sell for only $24.95 and $17.95 respectively.

What do you do with these after you've bought 'em and assmbled 'em? Well, there are many circuits that can be calculated by Ohms Law for a rough approximation, then you either have to build in a potentiometer to allow for individual variations in the circuit or else you have to connect one temporarily, adjust it for best operation of the circuit and then replace it with a resistor of an equal value. With the decade box around you can hook it in the circuit, adjust and then read the desired resistance from the dials. It is a lot handier to use than a flopping pot.

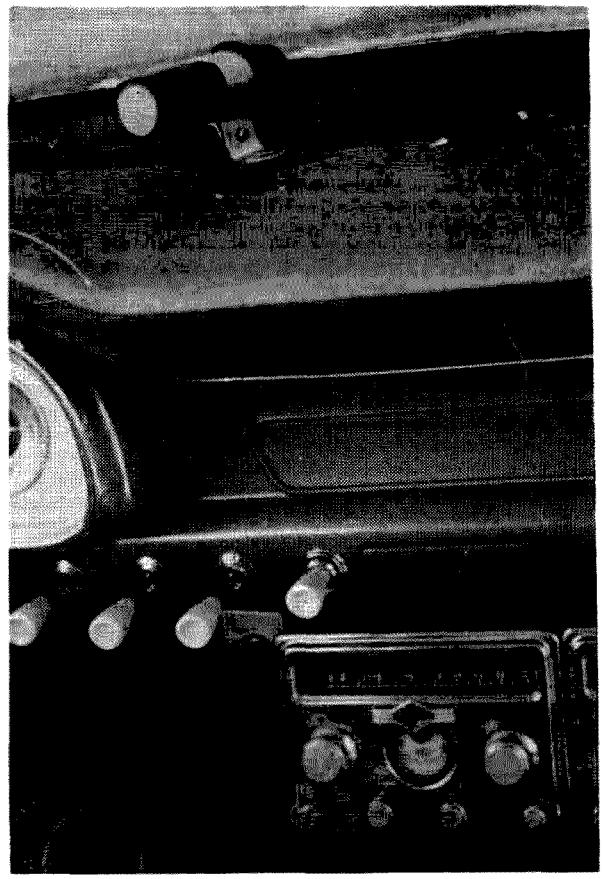
Or maybe you hook up a bridge circuit now and then for some particular application. With this decade you can assemble a bridge by means of a few clip leads, make your measurements, take it apart again . . . and get the accuracy that you wanted.

If you do any tuning of filters it is difficult to get along without a decade.

All in all, no test bench is really even half complete without a set of decades at hand. Like inside plumbing, you never really appreciate it until you have one of your own.

Mobile Monitor Scope

Robert Williams K9DYS
7 Willows Place
Rantoul, Ill.



Photographed by S/Sgt. John Matheson, USAF

DURING the course of experimenting with transistorized mobile modulation systems, the desire for a means of monitoring performance of the rig on the road led to the adoption of the miniature scope shown here. The 1" screen is mounted out of the way on the dash and can be sen without turning your head from the road. It can be used for either AM or SB. The power requirements are so small the scope can be run from flashlight batteries.

The scope tube is an RCA 913. The high voltage requirement is supplied by a small transistor oscillator putting out 300 to 400 volts at approximately 100 micro amps.

The 913 filament is turned on by the transmitter on-off switch. To prevent a bright spot from burning the screen during stand-by the power supply is turned on with the push-to-talk system, thus the screen is dark during stand-by.

Construction

The power supply and controls are built into a 2¼ x 2¼ x 5" Bud Mini box which is

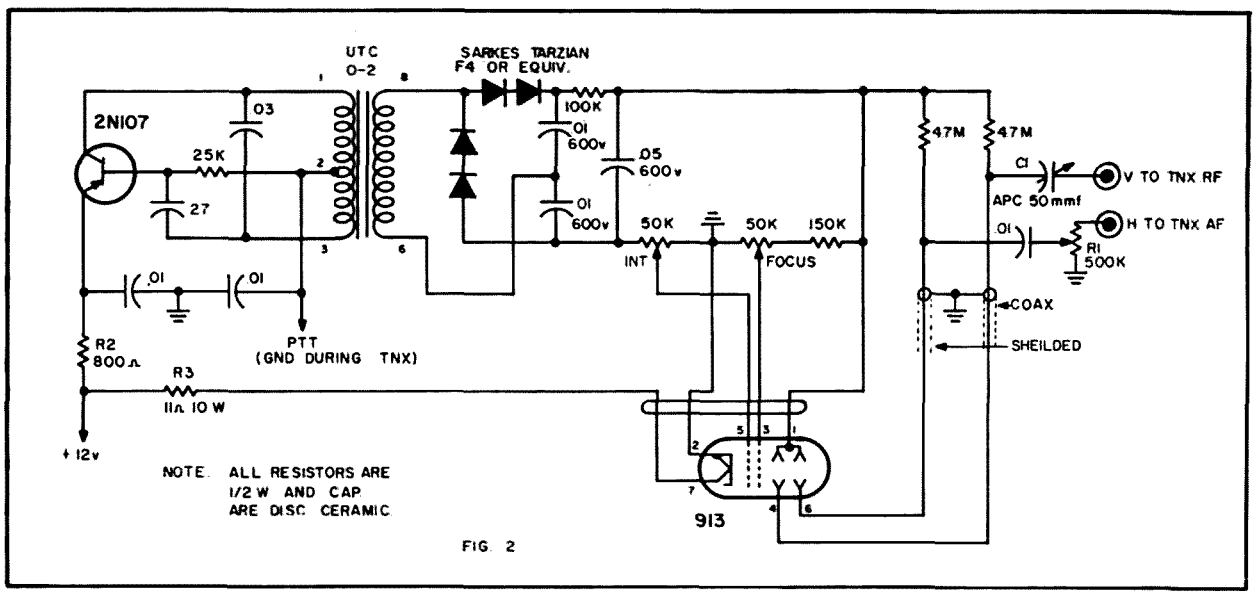


FIG. 2

mounted out of sight under the dash. Only the tube and it's socket are visible. The only important thing to remember about contruction is that the oscillator must be shielded from the other components to prevent undesirable traces. The 913 can be replaced by a 2AP1, but it is somewhat large for dash mounting. The 2AP1 requires a different value filament dropping resistor.

The audio is brought into the scope by a shielded lead from a capacitor connected to the PA side of the modulation transformer. Rf is obtained from a tee connector on the transmitter's antenna plug. Coax cable is used for the rf leads. Connections shown in Fig. 1 are for a trapezoidial pattern.

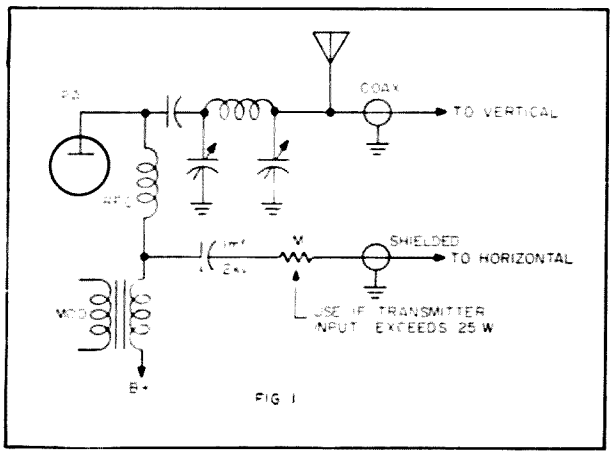


FIG 1

The aluminum bracket, holding the CRT, was made from scraps around the shack and is held in place by one of the bolts in the speaker grill.

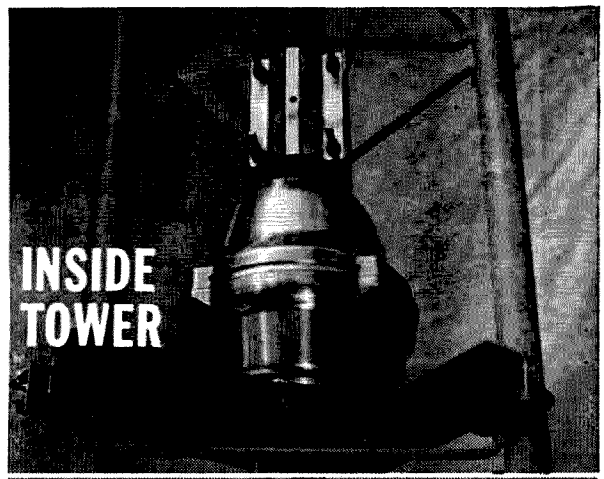
Operations

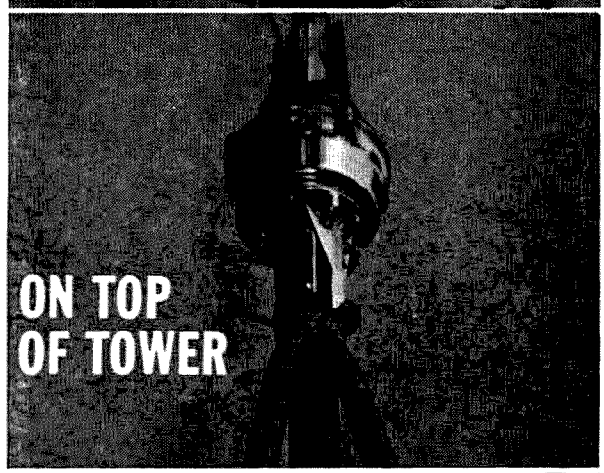
If it is desired to make the scope completely self contained for portable use only a few changes are required. Increase the chassis size to accommodate the 913 and a 6 volt battery, 4 size D cells or a 6 volt lantern battery such as RCA VS040s. Remove the filament dropping resistor R3, for the 913 and remove R2 in the power supply. The brightness, although decreased, should still be sufficient.

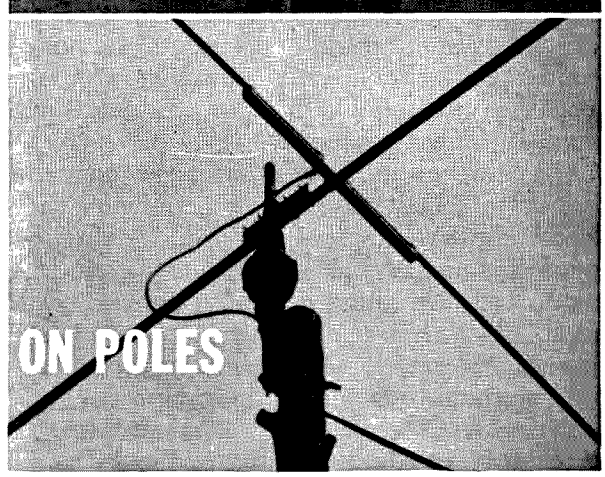
After tuning the transmitter, adjust C1 with an insulated screwdriver (the rotor of C1 is hot) for a narrow line that fills about ¾ of the 913 screen. This is done without modulation and indicates carrier magnitude. Next loosen the CRT clamp and rotate the tube until the line is vertical.

Now apply modulation and adjust R1 for proper horizontal size and you are in business.

The pattern should be a trapezoid which is used here. For interpretation of the pattern refer to the ARRL Handbook.







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During the experimental stages, the 913 was mounted on the steering column and the pattern could be seen reflected on the windshield without obstructing vision. This worked quite well, but the combination of XYL, harmonics and HV at the CRT plug, put the monitor on top of the dash.

The monitor has been in use for almost a year, and I am quite pleased with it.

Now I can adjust the rig at anytime for 100% modulation without using those often inadequate signal reports. Also, I can tune the rig without taking my eyes off the road.

. . . K9DYS

More fun with a Communications Receiver

Elliott Weyer W2LLZ

THE real purpose of a good ham receiver is to provide efficient reception on the amateur bands; however, there may be times (transmitter breakdown?) when there is an urge to use a great receiver in other than its intended rôle—Short Wave Listening! Current trends in communication receiver design are in the direction of less band-coverage and toward narrower frequency response—restrictions which make the 75A-4, for example, almost as useless for SWL as for bird watching. On the other hand, the precise calibration of the 75A-4 makes it possible to locate an out-of-bandspread station with unfailing accuracy, and then to enjoy a foreign broadcast with excellent quality reception.

To achieve these results, a simple converter is part of the story. The rest is only for those who believe in high fidelity, and consists in removing one of the Mechanical Filters from its rack and bridging the *if* "straight through" with "U's" of wire inserted in the socket as shown. (Please do not throw away the filter).

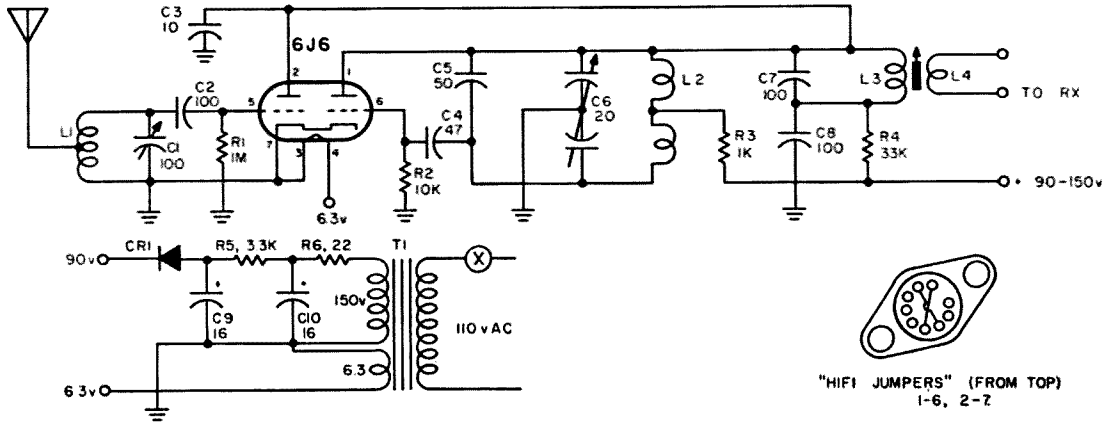
Transistor bugs will go their minuscule way, but we have had very satisfactory results with a one-tube oscillator-mixer circuit, very simple to construct. The oscillator circuit with its padder will sweep the frequencies from about 4.0 mc up to about 8.25 mc putting within easy reach most of the important short wave broadcasting stations of the world as well as other services too numerous to mention, but probably including for the first time—Sputniks!

Consider, for example, the overseas broadcast stations of the BBC. It will be noted that none of them may be tuned directly on the 75A-4. First line in tabulation below lists those broadcast frequencies. Below them are oscillator frequencies which may be precision-set by reference to bands on the receiver, and in the last row are indicated the points at which the BBC will appear on the receiver. The elegant calibration of the 75A-4 and its 100 kc crystal check points make it possible to pre-set the combination for a desired station with assurance that it will appear on the bandspread precisely according to calculations.

BBC, kc:	15.375	11.780	9.825	9.510	6.195
Set Osc:	7.700	4.000	7.800	7.100	4.100
Tune to:	7.675	7.780	2.025	2.410	2.095

Newcomers to the field of heterodynology will be rudely jolted by the obvious fact that in beating one frequency against another, the resultants are *two*—the sum of, and the difference between, the two frequencies. Hence, some strange bedfellows are bound to turn up. However, it is usually possible with simple mathematical juggling to get just what you are looking for, and get it without QRM. Of course, if it's the domestic broadcast band you want, it is there too, and not afraid to assert itself.

The 75A-4, its kin and issue share many qualities of good receivers for this purpose,



among them the fact that without an antenna, they hear almost nothing. Lesser breeds, which will pick up signals by osmosis as well as through the usual channels, will make the pastime even more sportive.

The Converter

All parts of the simple circuit are easily mounted on and in a standard 5 x 7 x 2" aluminum chassis. A geared-down drive for the split-stator capacitor is almost a "must" to facilitate exact oscillator tuning, although no dial or calibration are necessary, or would they mean anything anyway in view of the padding condenser. There is ample room within the chassis for the miniature power supply, if it is not desirable to "borrow" power from the receiver.

C_5, C_6, L_2 and 6J6 are on top of the chassis; all other parts are below deck. The converter is fitted with RCA input and output jack and plug, and in use, converter is inserted in a break in the coax from antenna to communications receiver. (The break in coax is so fitted that continuity may be restored after your transmitter is again in working order).

In using the converter, the following routine will become almost automatic: 1) Obtain frequency of desired station in megacycles,

2) Using the coverages of the bands of the communication receiver, select two tunable points such that their sum or difference will result in the desired (but otherwise unattainable) frequency.

3) Set receiver for reception exactly on one of these frequencies using crystal calibrator at nearest check point for accuracy.

4) Without connecting the converter to receiver "swish" around with C_5, and finally C_6, to zero-beat converter oscillator with receiver BFO.

5) Tune receiver to other of the frequencies derived by computation in 2) above; insert converter in antenna coax, and listen to your station.

"Tuning around" may be performed by either the bandspread of the receiver or the oscillator of the converter of course. Is it a Barrel of Monkeys or Pandora's Box?

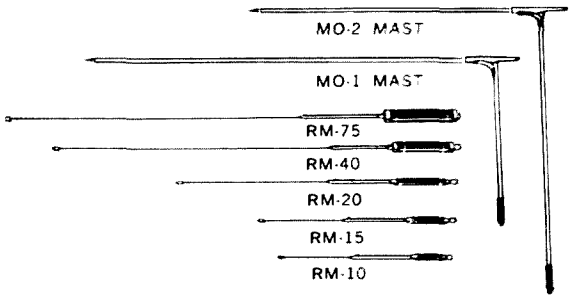
. . . W2LLZ

T1—Small light-weight transformer of (isolation type—surplus) 110 v. in, 150, 6.3 v. out.
CR1—Selenium rectifier, 20 ma. capacity.
C6—Split-Stator "butterfly" or two opposed section; total about 20 mmf.
L1—1" of Miniductor ½" in diameter, 16 turns/in. air-wound; tap 4 turns fm. gd.
L2—16 turns #26 Enamel closewound on 1" form, center-tapped.
L3—24 turns #26 Enamel on ⅜" slug-tuned form.
L4—4 turns #26 Enamel at ground end of L3 above.
All resistors ½ Watt; all fixed capacitors (except electrolytics) ceramic disc.

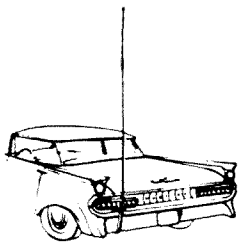
GOOD MOBILES GO

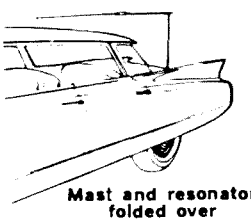
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10-15-20-40-75- METERS



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Mast and resonator in mobiling position

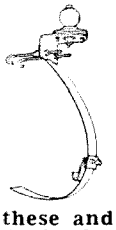

Mast and resonator folded over

RESONATOR WILL WORK PROPERLY ONLY IF USED WITH MO-1 OR MO-2 MASTS. ANTENNA ASSEMBLY CONSISTS OF 1 MAST and 1 RESONATOR.

MODEL	DESCRIPTION	TOT. HGT. of ASSY.	NET
MO- 1	54" mast folds at 15" fr. base	Rear deck or fender	$ 7.95
MO- 2	54" mast folds at 27" fr. base	Bumper	7.95
RM-10	10 meter resonator	80" max. - 75" min.	5.95
RM-15	15 meter resonator	81" max. - 76" min.	6.95
RM-20	20 meter resonator	83" max. - 78" min.	7.95
RM-40	40 meter resonator	92" max. - 87" min.	9.95
RM-75	75 meter resonator	97" max. - 91" min.	11.95

ANY MAST OR RESONATOR MAY BE PURCHASED SEPARATELY

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The TT-180 Five Bander

Frederick J. Haines W2RWJ
123 Roberta Drive
Liverpool, New York

A few months ago I decided to return to the air after a period of inactivity. The inclination was to build something fast and simple, perhaps a 6AG7-6L6 crystal controlled rig on an old-fashioned breadboard.

At this point judgment began to prevail over impulsive action. Wouldn't it be rather silly to build a transmitter for one or two bands, when all that hard-earned dough had just been shelled out for a new all-band receiver?

Several weeks were spent developing a set of specifications for the new rig, and after some preliminary design work, it was clear that construction of an all-band medium-power transmitter isn't as formidable a task as had been assumed.

The resulting unit is a five band, seven tube, bandswitching rig, with a dc power input of 180 watts into a twin tetrode final amplifier.

Technical Summary

Power. 117 volts ac at approximately 60 watts for tube heaters and blower. 600 volts at 300 ma or 750 volts at 240 ma and 360-375 volts at 100 ma, all dc. For AM phone the final requires 600 volts at 224 ma.

Signal. Internal crystal - controlled oscillator (VFO-CRYSTAL switch on chassis). Any VFO with an output of a few tenths of a watt to drive the input stage, VI.

AM Modulation. Any modulator delivering 65 watts of audio at an impedance of approximately 3800 ohms will 100% modulate the transmitter at a final amplifier input power of 134.5 watts.

Outputs, measured at 3.5 mc.

CW Telegraphy. 600 plate volts, 125 watts output (180 watts input); 750 plate volts, 130 watts output (180 watts input).

AM Phone. 600 plate volts, 100 watts output (134.5 watts input).

Impedance. The pi-network output circuit matches 50 or 75 ohm coaxial transmission lines to antenna tuner or antenna.

Circuit

A type 5763 pentode functioning as a modified Pierce crystal oscillator or an amplifier-doubler is employed at V1. The plate tank circuit, L1-C3, tunes to either 80 or 40 meters depending upon the position of the exciter bandswitch S2. When an 80 meter crystal or VFO is used, V1 provides output on either 80 or 40, acting as a doubler for 40 meters. When starting with a 40 meter crystal or VFO the stage amplifies straight through on 40.

C6 pads the V1 tank circuit down to the 80 meter band when S2 is in the 80 meter position. The screen grid of V1 is controlled by the EXCITATION control R4 to allow the final amplifier grid drive current to be set at the correct value.

V2 serves to double the 40 meter output from V1 to 20, or to triple to the 15 meter band when S2 is in the 20/15 meter position. The plate circuit of V2 is arranged to tune to both 20 and 15 meters, thus eliminating the need for separate 20 and 15 meter multiplier stages.

When 10 meter output is desired, V3 is switched into the circuit and doubles 20 meter output from V2 to 28 mc.

The function of C15 is to make the grid circuit of V3 present the same capacitance as the final amplifier grid circuit. This provides resonance at 20 meters at a single setting of C11 whether V2 drives the final grid or the grid of V3.

Drive from V1, V2, or V3, is coupled to the grids of the parallel 6146's final amplifiers through a section of the EXCITER BAND-SWITCH, S2C. The coupling capacitors are C7, C8, C16, or C21, the one in use depending upon the setting of S2. M1 monitors the PA

grid current and indicates resonance of the driver tank circuits.

V4 and V5 were found to be miserably normal as far as parasitic oscillations were concerned. They were quite willing to produce spurious output with no encouragement. R12 and R13 were found to be "musts" as well as R14 and R15 in the screen leads. R16 and R17 with RFC-6, and RFC-7 will be recognized as the usual plate parasitic networks.

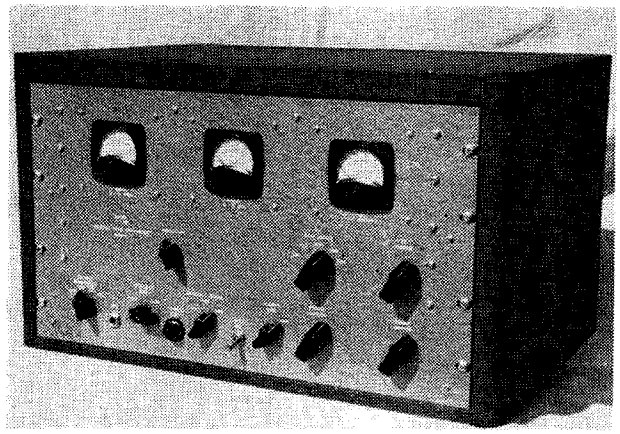
In order to allow keying of the driver stages, the final amplifier screen grid circuit incorporates the usual clamp tube V7, a type 6V6. When grid drive is removed from the final grid, the bias of V7 falls to zero and the tube draws current heavily through R19, the screen dropping resistor. When V7 conducts through R19, the voltage at the plate of the "switch" tube, V6, falls below the value required to maintain ionization and V6 extinguishes. At this point the final screens are actually disconnected from the screen supply and final plate current drops to a very low value.

A bonus advantage of the "switch" tube is that the gas requires a time to ionize, providing a measure of shaping of the CW keying characteristic, tending to "soften" the keying and minimize key clicks that otherwise might be radiated.

The plate tuning capacitor, C31, in combination with the plate inductor L6-L9 tunes to the five Amateur bands between 3.5 and 29.7 mc. The PA BANDSWITCH S3 shorts out turns progressively to provide the proper amount of inductance for each frequency band. This system of fixed inductance value for each band eliminates the usual inconvenience found whenever a rotary inductor is employed. No turns counter is required and band-changing is greatly simplified. In addition, the best circuit Q possible is built into the transmitter and is automatically selected by the operator without consultation of tuning charts.

Both COARSE and VERNIER LOADING controls were provided in the original model of the transmitter. If it is desired to simplify the circuit and minimize the mechanical complexity, the VERNIER LOADING capacitor, C32, may be omitted, and the COARSE LOADING switch rewired as shown in schematic.

It was found necessary to neutralize the final amplifier on the three higher frequency bands. The amplifier did not oscillate without neutralization, but it was found that maximum rf output did not coincide with minimum plate current as the final tank was tuned through resonance. Due to the long leads required and also because the final amplifier grid circuit doth not have its own coils and tuning capacitors, it would have been impossible to use the popular capacitive bridge method of neutralization. A search of the handbooks revealed a simple and effective but little used method of neutralization. As will be noted on the schematic diagram, two link neutralizing circuits are used. L5 and L7, connected together by a twisted pair of hook-up wire, couple some final amplifier plate tank energy back to the 10 meter doubler tank, L4. On ten meters the final amplifier grid tank is actually the V3 plate tank. When L5 and L7 are properly phased and the amount of rf coupling optimized, complete neutralization is obtained on the ten meter band. L3 and L8 accomplish the same for the twenty and fifteen meter bands. In the latter case however, one link coil is placed between the 20 and 15 meter portions of the plate tank coil and neutralization of both bands is accomplished simultaneously.



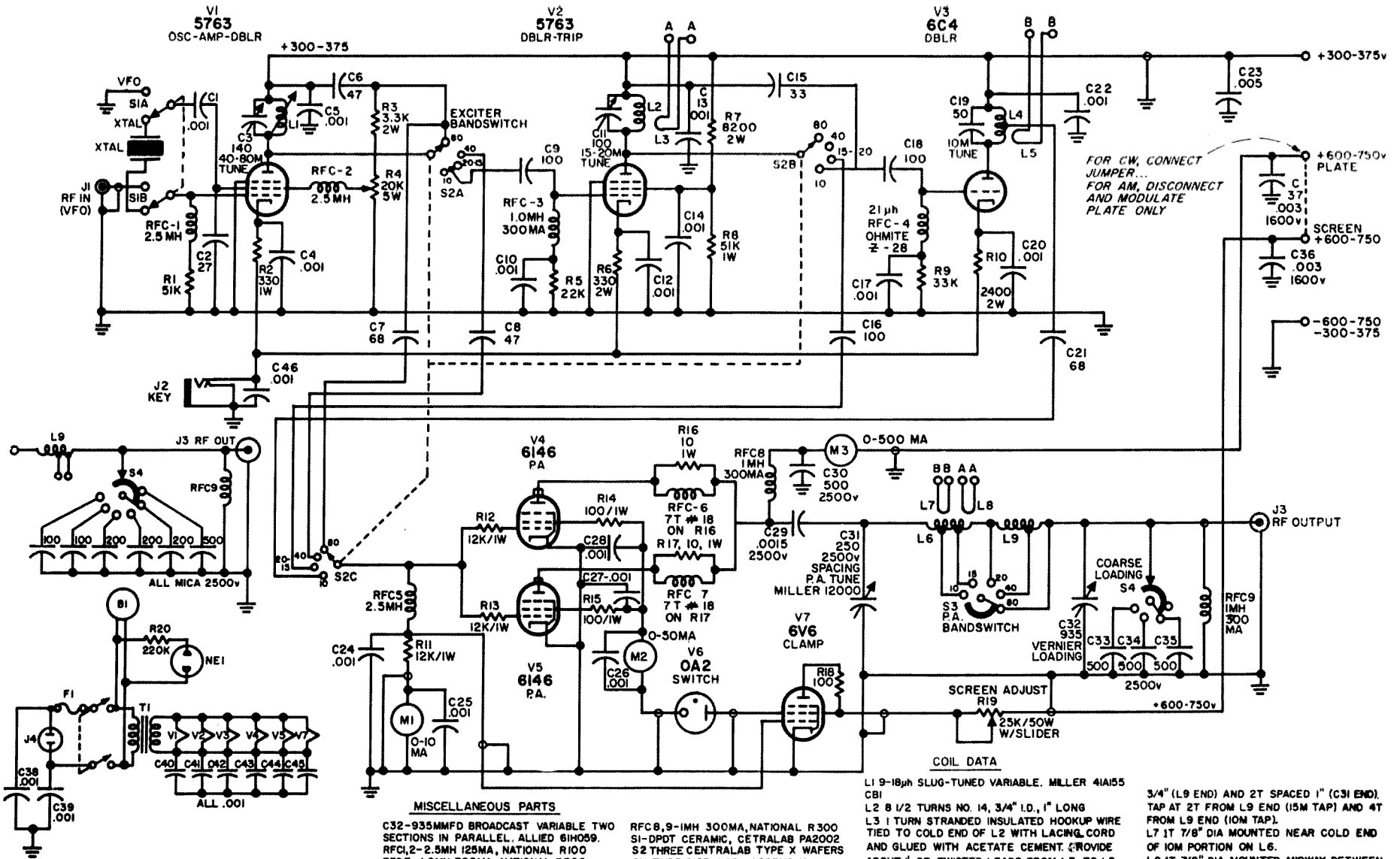
TVI Precautions

The major factors contributing to the freedom from TVI enjoyed with TT-180 transmitter are the excellent shielded enclosure and adequate by-passing of all leads entering and leaving the rig. Use of a link-coupled antenna tuner or a low-pass, low-impedance filter is absolutely required if TVI is to be minimized. Installation of C23, C36, C37, C40 through C46, C38 and C39 must be accomplished as outlined in the chapter on TVI of the Radio Amateur's Handbook.

Layout

The sides, top, bottom, and rear shield plates which make up the TVI shield enclosure were fabricated from 20 gauge sheet aluminum. They are mounted on a framework of ½ x ⅜-inch aluminum bar stock, tapped for 6-32 screws about every two inches. Wherever the chassis and side plates contact the rear of the front panel, the paint was removed from the panel to insure good contact and to minimize TVI.

The area directly over the 6146 final amplifier tubes was cutout approximately 4½ by 6 inches and covered from the bottom side with perforated sheet aluminum for ventilation. The area over the XTAL-VFO switch was also cut out, about 3½ by 5½ inches to allow access to the switch and the exciter tubes. The edges of the hole were lined with Eimac contact finger stock to provide a leak-proof removable



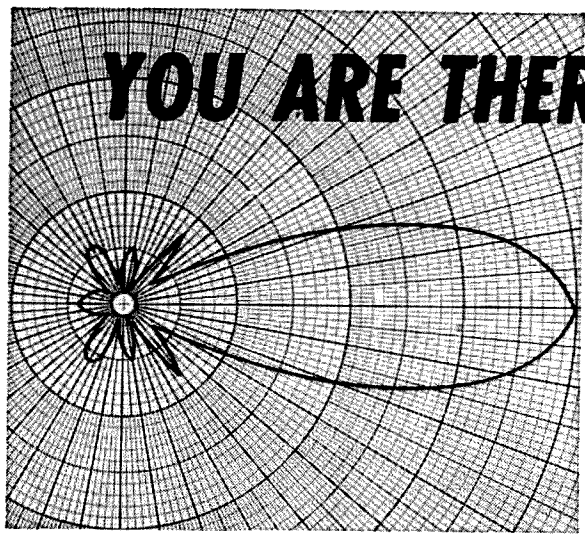
ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED. ALL CAPACITORS ARE 500 VOLTS UNLESS OTHERWISE NOTED.

MISCELLANEOUS PARTS

C32-935MMFD BROADCAST VARIABLE TWO SECTIONS IN PARALLEL, ALLIED 61H059.
RFC1,2-2.5MH 125MA, NATIONAL R100
RFC3-1.0MH 300MA, NATIONAL R300
RFC4-21µH, OHMITE Z28
RFC5-2.5MH 125MA
RFC 6,7-7 TURNS NO. 18 SOLID WOUND OVER FULL LENGTH OF R16 & R17.
RFC8,9-1MH 300MA, NATIONAL R300
S1-DPDT CERAMIC, CETRALAB PA2002
S2 THREE CENTRALAB TYPE X WAFERS ON TYPE P123 INDEX ASSEMBLY.
S3,4-CENTRALAB P1S PROGRESSIVELY SHORTING CERAMIC SWITCH SECTION. TYPE P121 INDEX ASSEMBLY.

COIL DATA

L1 9-18µh SLUG-TUNED VARIABLE. MILLER 41A155 CBI
L2 8 1/2 TURNS NO. 14, 3/4" I.D., 1" LONG
L3 1 TURN STRANDED INSULATED HOOKUP WIRE TIED TO COLD END OF L2 WITH LACING CORD AND GLUED WITH ACETATE CEMENT. PROVIDE ABOUT 1' OF TWISTED LEADS FROM L3 TO L8.
L4 5 1/2 NO. 12 SOLID, 3/4" I.D., 1" LONG. TAP 1T FROM TOP END FOR C21 CONNECT.
L5 SAME AS L3 BUT ATTACHED TO L4.
L6 6T NO. 12, 1 1/2" ID, 1 3/4" LONG. 4T SPACED 3/4" (L9 END) AND 2T SPACED 1" (C31 END). TAP AT 2T FROM L9 END (15M TAP) AND 4T FROM L9 END (10M TAP).
L7 1T 7/8" DIA MOUNTED NEAR COLD END OF 10M PORTION ON L6.
L8 1T 7/8" DIA MOUNTED MIDWAY BETWEEN 20 AND 15M SECTIONS OF L6.
L9 22T NO. 16 1 1/2" DIA 2" LONG, B&W JEL-40 WITH LINK REMOVED. TAP 1T FROM END (40M TAP).



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cover plate which is fastened by two 6-32 wing nuts for fast removal.

The three panel meters are shielded from the rear by 4X4X2 inch aluminum utility boxes bolted to the rear of the front panel. Again, the areas under the edges of the meter shield boxes are scraped free of paint to insure good contact. Holes are drilled in the bottoms of the meter boxes to allow the meter leads to pass through rubber grommets.

Across the front of the chassis are the three tank capacitors for the tank circuits of V1, V2, and V3. The three tubes are located near their respective tuning circuits. The EXCITER BANDSWITCH, S2, is located to the rear of the exciter tube socks under the chassis and runs parallel to the front panel, being driven through a right-angle drive mechanism. Suitable "L" brackets are made to support the drive mechanism (Millen type 10012) and the switch assembly. The tuning capacitors, C3, C11, and C19, are mounted to the panel so their shafts protrude through ⅜" clearance holes. This is required because the capacitor shafts are at 360-375 volts dc. In order to insure against shock, the knobs used here must have deep-set set screws, and the set screw holes should be filled with glazing compound after the screws are tightened to prevent any possibility of contact with the set screws. The capacitors used for C3, C11, and C19 do not come equipped with ¼-inch shafts for knobs. To remedy this, ½" lengths of ¼" diameter brass rod were cut and soldered to the existing capacitor shafts.

The final amplifier tank components are mounted above the chassis on the right side, the tank tuning capacitor, C31, being to the front of V4 and V5 nearest the front panel. A shaft coupling and a quarter inch aluminum shaft were employed to extend the capacitor shaft through the front panel bushing. To the left of C31 is the PA BANDSWITCH, S3, mounted on an aluminum "L" bracket whose height is chosen so the shaft of S3 comes through the front panel at the same height as the shaft of C31. Immediately behind S3 is the COARSE LOADING switch, S4. In order to maintain a functional grouping of front panel controls, S4 is mounted vertically through the chassis and driven through another Millen right-angle drive mechanism. Another important reason for this mounting arrangement is to keep all final amplifier circuit elements above the chassis to prevent feedback to the grid circuit components which are all below the chassis.

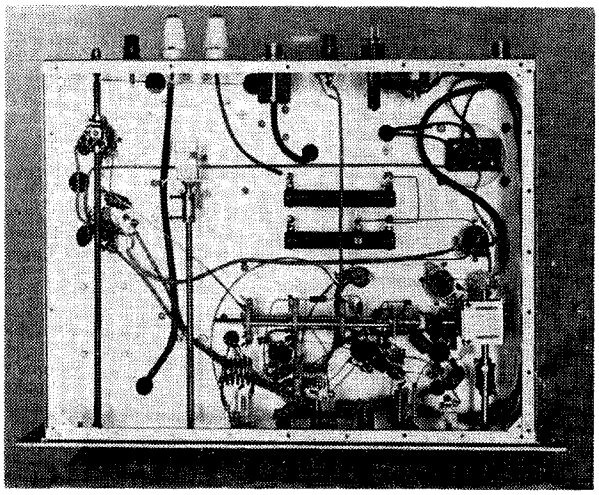
If it is decided to use the VERNIER LOADING capacitor, C32, note that it is mounted to the left and rear of S4 and driven through two holes in the chassis by a dial cord. The dial cord in turn is driven by a ¼-inch shaft below the chassis supported by two panel bushings, one at either end. The capacitor was obtained from a discarded broadcast receiver and came equipped with a large dial cord pulley and spring tension device. Two clearance holes were made in the chassis to pass the dial cord.

The plate RFC, RFC-8, is mounted between V4 and V5, with plate by-pass C30 mounted with the shortest possible leads from the bottom terminal of the choke to the chassis. An octal socket-size hole was punched through the chassis near the ground connection of C30 to provide a short rf path from the plate circuit through the chassis to the cathode terminals of the final tubes under the chassis. This was found to be important in terms of TVI suppression.

The exciter portion of the rig, V1, V2, and V3, is wired by the point-to-point method, all disc ceramic capacitors being connected with

leads about ¼" long or shorter. The unused terminals on the EXCITER BANDSWITCH, S2 were used to provide terminal connection points for many components, notably, R2, R3, R6, R7 and the 360-375 volt dc line. All of the coupling capacitors associated with the bandswitched circuits were mounted directly on the bandswitch, S2.

The exciter tank coils, L2 and L4 are soldered directly on their tuning capacitors, C11 and C19. L1, a stud-mounted slug-tuned coil, is on the chassis near the connections of C3 and near V1.



The neutralizing coils, L3 and L5, are made from single loops of flexible hook-up wire and are made up with twisted leads about 18 inches long to extend through grommet lined holes in the chassis up to the final tank coil area. The coils are tied to the "cold" ends of L2 and L4 with lacing cord and then cemented with acetate cement. L7 and L8 are supported by two-terminal tie strips atop 1¼" high ceramic spacers near L6, and the twisted leads from L3 and L5 are trimmed to length and connected to L7 and L8.

The grid parasitic suppressors, R12 and R13, are mounted as close to the tube sockets as possible, as are the screen suppressors, R14 and R15. C28 and C27 are mounted as closely to the resistors as possible and grounded through ⅛" leads for low-impedance screen grounding.

The final tank coils and coupling capacitor, C29, are mounted on 1¼" high ceramic spacers threaded for 6-32 screws at both ends. The coil connections to the PA BANDSWITCH are made with strips of copper sheet ¼" wide to minimize rf losses at the higher frequencies.

All power wiring, including the high voltage leads was done with shielded cable, RG-59/U coax being used for all leads carrying in excess of 400 volts. The shields were grounded at both ends of each run.

It is important to connect all cathode pins of V4 and V5 together with heavy solid wire and to ground pins 1, 4, and 6 to the socket ground lugs. The rotor lead from S2C to the final grid circuit is made with a length of number 14 solid wire.

The leads entering the meter shield boxes must be shielded and the shields grounded just *before* the leads enter the boxes to prevent harmonic currents from flowing inside the boxes and on out to the front panel surface.

The loading capacitors associated with the COARSE LOADING switch, S4, are run down from the switch directly to ground lugs on the chassis.

Adjustment and Operation

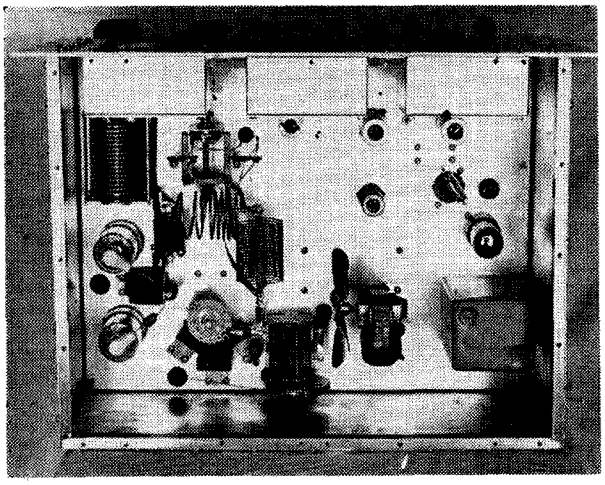
After all wiring is complete and has been double checked for wiring errors, connect the ac cord to the chassis and turn on the HEATERS switch, S5. Check for blower operation and be certain all tube heaters are lighted.

Next, connect the 360-375 volt dc power (do not connect the high voltage) and place the EXCITER BANDSWITCH, S2, in the 80 meter position. With an 80 meter crystal in the crystal socket and S1 in the XTAL position, depress the key and tune C3 until grid drive is registered on M1. 80 meter drive should be obtained with C3 nearest to maximum capacitance. With C3 at resonance and the EXCITATION control, R4, at maximum clockwise position, the grid current meter should register at least 10 ma of grid drive. Do not leave the key down for more than a few seconds with grid drive in excess of 5 or 6 ma in order not to damage the final amplifier tubes.

Change the EXCITER BANDSWITCH to the 40 meter position and again depress the key and tune for final grid drive. The oscillator stage is now doubling from 80 to 40 meters and drive in excess of 10 ma should be found. If output on 80 and 40 are not obtained as outlined above, change the setting of the tuning slug in L1 (a grid dip meter is useful here) until both 80 and 40 meter outputs are obtained. 80 meter resonance should occur at about "2 o'clock" and 40 meter resonance at about "10 o'clock." The decals are installed in the proper positions to indicate the approximate knob settings for resonance on either band.

If a VFO is used, repeat the above procedure using a VFO with 80 meter output fed into J1. Set the XTAL-VFO switch to the VFO position. If it is not planned to operate on 80 meters then a VFO with output on 40 may be employed. In either case, the EXCITER BANDSWITCH must be set to the appropriate band.

With V1 set up as above to deliver 40 meter output, switch S2 to the 20/15 meter position and with the key depressed resonate C11 to the 20 meter position, near "2 o'clock" on the dial. Grid current in excess of the required 5 or 6 ma should flow. Note that C11 allows doubling to 20 or tripling to 15 meters at the same EXCITER BANDSWITCH position. Grid drive on 15 should be found near the "10 o'clock" position of the C11 knob. A grid dip



meter is useful at this point to make certain that resonance is occurring at the desired frequencies.

Operation of the 10 meter doubler, V3, is checked with V1 set for 40 meter output, V2 set up for 20 meter output, and the EXCITER BANDSWITCH in the 10 meter position. Resonate C19 for 10 meter grid drive.

Neutralize the transmitter as follows. With the RF OUT jack, J3, connected to ground through a 75-ohm ½ watt resistor (no high voltage), and both bandswitches in the 10 meter position, obtain a grid drive of 6 ma on M1. Rotate the PA TUNING capacitor slowly through the resonance and note whether M1 "flicks" slightly as the resonant point is passed through. Adjust the position of L7 with relation to L6 until no variation of M1 occurs as the PA TUNING is moved through 10 meter resonance. For the most sensitive indication, set S4 for minimum capacitance. If neutralization cannot be obtained, interchange the wires from L5 where they connect with L7 and try again. The proper position of L7 is directly over the 10 meter tap of L6 at the "cold" end of the 10 meter section of the coil.

Repeat the above procedure with first 20 meter grid drive and the PA BANDSWITCH in the 20 meter position, and then 15 meter grid drive and the PA BANDSWITCH in the 15 meter position. Adjust L8 for minimum grid current variation as the PA TUNING is passed through resonance on the two bands. Note that the adjustment of L8 is a compromise between the two bands and that the position of L8 is halfway between the 20 and 15 meter taps of L6.

When the exciter portion of the rig has been checked out and the rig has been neutralized as outlined above, make up a dummy load consisting of a 150 watt light bulb connected to a short length of coaxial cable with a rf connector to connect the RF OUT jack, J3.

Before connecting the high voltage to the rig, set the COARSE LOADING switch, S4, for maximum capacitance and adjust R19 with an ohmmeter for a resistance of approximately 15,000 ohms. Next set up the exciter to provide 6 ma of 80 meter grid drive to the final. Now connect the high voltage lead (power turned off!) and with the 80 meter position indicated by the PA BANDSWITCH, turn on the high voltage supply. Note the reading of the PLATE meter, M3, which should not read more than 40 ma or so. Depress the key and immediately rotate the PA TUNING control until the resonant dip of plate current is found. Do not hold the key down for more than a few seconds until resonance is positively established to avoid overdissipating the final amplifier tubes.

Advance the COARSE LOADING control a step at a time while maintaining resonance with the PA TUNING control until a final plate current of about 240 ma (if 750 plate volts) or 300 ma (if 600 plate volts) is obtained. The VERNIER LOADING control can be used to trim the current to the exact value. At this point the 150 watt light bulb should be burning at near full brightness. When the key is released, the screen "switch" tube, V6 should go out, and the plate current should drop to 30 or 40 ma.

Using proper caution against shock, measure the screen grid voltage with the key depressed and the rig fully loaded into the dummy load. If 600 plate volts is used, adjust R19 for a screen voltage of 180. If 750 plate volts is used, adjust R19 for 160 screen volts. If the rig is to be plate modulated, the plate voltage must be no higher than 600 and the screen voltage must be 150 volts.

Repeat the tuning procedure for each of the remaining bands with the exciter set up to deliver grid drive on each band and the PA BANDSWITCH and PA TUNING adjusted accordingly. All bandswitching should be done with the high voltage turned off in order to prevent burning of the switch contacts. If the key is left up bandswitching can be done with the high voltage left on.

Note that the loading controls provide maximum loading at the minimum capacitance position.

The screen grid total current on M2 should be between 18 and 22 ma when the final voltages currents and loading are correct.

When plate modulating the transmitter, disconnect the jumper between the plate and screen high voltage terminals at the rear of the chassis. Feed modulated high voltage to the plate and unmodulated to the screen. A modulator output impedance of about 3800 ohms is correct with 600 plate volts and the recommended 224 ma of plate current. With plate modulation, the grid drive current must be higher than for CW operation, about 6.5 to 7 ma.

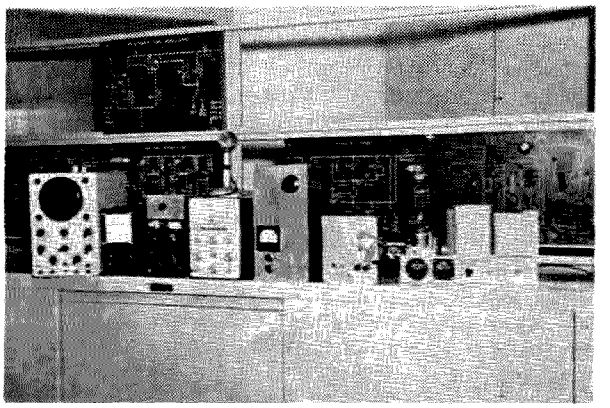
Operation, stability, and results have been particularly gratifying with the TT-180 in the several months this rig has been on the air at W2RWJ. Reports have been consistently above average, and I am quite pleased that the 6AG7-6L6 combination went by the board. Good luck with your TT-180! . . . W2RWJ

The Instantaneous Dissipator Tube

A Versatile Medium Powered Final Amplifier Using An Unusual Power Supply And A Special Voltage Regulator

Robert Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

THE purposes of this article are threefold. First will be the use of the voltage doubler circuit for a medium high voltage power supply. Second will be a special voltage regulator to be added to the power supply which will work under the difficult working conditions of a single side band linear. Third will be the amplifier itself which though not entirely unique, can be used in several modes of operation with all band operation and it fills out the complete picture of the three units working together.



The Power Supply

There are all kinds of chunky TV replacement transformers available to hams at the present time. Being the proud owner of a couple of these I began to wonder how I could use them for a ham power supply. 350 volts isn't very much and 700 out of a bridge has its limitations, but you might really be able to do something with 1400. So I began to speculate about using a voltage doubler circuit. For the past several years I have used a pair of 5R4GY's in a voltage doubler using existing filament windings on one of these TV transformers and it isn't hard to get 1500 volts at 100 ma. This gets both bulky and hot and you worry about the insulation in the filament windings. Now comes the day of the cheap silicon rectifier. Just what the doctor ordered.

A common mistake among hams is to assume that they can stick in a couple of 400 volt inverse peak silicons in place of a 5U4 in just any old power supply and everything will be just dandy. So they turn on the juice and POOOOF! Nope, they *were* good rectifiers. You just didn't use the old bean. Take a gander at Fig. 1.

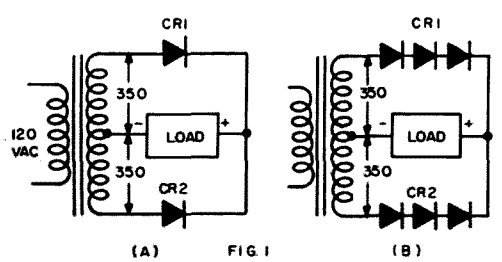


FIG. 1

In the first place the 350 volts is RMS so the peak voltage is 350 x 1.414 or nearly 500 volts. In the second place let's consider rectifier CR_1 in the conducting condition and CR_2 in the non-conducting condition: If CR_1 is conducting there is very very little drop across it; therefore, the entire voltage of both halves of the secondary is across CR_2 in the nonconducting or inverse direction. At the instant of peak voltage this amounts to approximately 1000 volts. Small wonder that your 400 volt inverse peak rectifier went POOOF! Thus it can be seen that to be on the safe side three of these silicon rectifiers should be in series on each side of the circuit. Fig. 1b.

Now the interesting part of the voltage doubler circuit is that you need exactly the same number of rectifiers to get 1400 volts as you need to get 350. See Fig. 2.

It can be seen that each set of rectifiers is working across the entire secondary separately or 700 volts RMS (1000 volts peak) which is the inverse voltage situation for the 350 volt full wave supply. In the voltage doubler case the capacitors charge up separately to 700

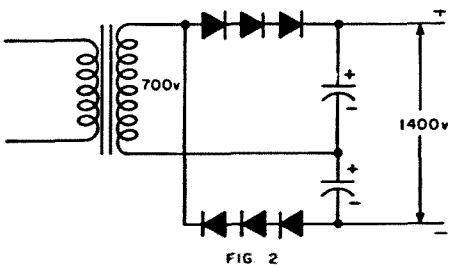
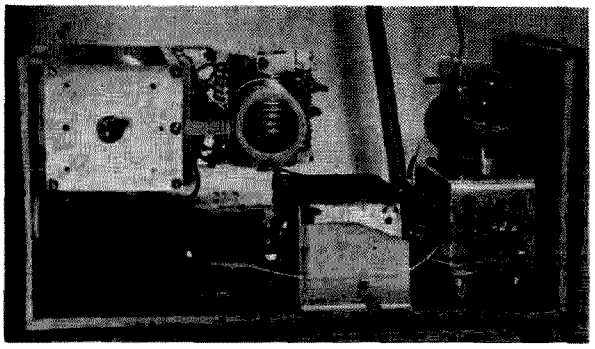


FIG. 2



volts each (between 700 and 1000 depending on the load) and discharge in series a total equal to the sum of the two. This may be on the order of 1400 to 1600 volts with a 200 ma load. Of course you would probably put in a filter choke and another filter capacitor in actual operation. If you use 10 mfd 1000 volt leader condensers and a 10 henry choke followed by another 4 to 8 mfd at 2000 volts, you have a good 1500 volt power supply for a constant load. It takes up a minimum of space too. If you are only interested in AM phone or possibly NBFM you can stop right here. But you better think twice if you anticipate CW or SSB operation. If you take off the load as you do when you lift the key or when you stop talking on SSB, your voltage will go sky high up to the peak double voltage. This is likely to lead to chirps or poor phone quality. Also if you have overrated your filter capacitors they may blow up.

The Instantaneous Dissipator Tube

For many years the voltage regulated power supply in the 300 to 400 volt range has been very common. These involve a regulator tube in series with 500 or 600 volts and can be designed to give extremely good voltage regulation. Very little application of this principle has been made for high voltage power supplies. Actually about all that has been done on high voltage supplies is to put in a fairly heavy bleeder to keep the voltage from going too high when the key is up or when the operator stops talking into a SSB rig.

Having listened to some of the high power SSB boys I have come to one conclusion. The stations that do not sound good probably have about 30% to 40% voltage regulation in the power supply furnishing power for the final linear amplifier. If they are close to class B the plate current excursion could run to several hundred mils and the supply is practically unloaded when the operator ceases to talk. This would give terrible regulation even to a standard full wave system. We have added insult to injury by putting in a voltage doubler system.

We will now develop what might be called a shunt voltage regulator, but I prefer to call it the *instantaneous dissipator tube* because this is the operation it performs. Essentially this is what the instantaneous dissipator does. When there is no excitation to the final amplifier either due to key up conditions or no speech on SSB, the tube is biased so that it will draw the same current as the amplifier would under peak conditions. When the amplifier is operating at peak condition the dissipator tube is cut off and draws no current. At intermediate points the combination of amplifier plate current and dissipator plate current add up to a total of the amplifier peak current. Thus under this condition, idealized, the power supply always has a constant load and consequently constant voltage would prevail. In practice this can be closely approximated.

This type of system calls for a big tube capable of dissipating the entire final amplifier input power at least for short periods of time. There are numerous surplus tubes on the market capable of serving this purpose. You can't buy 304TL's for 75 cents any longer, but I have seen 211's for about a dollar. And most hams have a half dozen dead Indians in the junk box. I came up with an HF-200, liberated from an obsolete diathermy machine some years ago. It was the first try and it worked. A couple of 211's should work equally well.

Now how do we get it to work? First determine the bias necessary for the dissipator tube to draw the right amount of current with transmitter at zero current. This can be done experimentally with a battery or if you have a separate filament transformer for the dissipator tube, cathode bias can be used. Find the proper size of resistor to put between the center tap and the B—. In my case the HF-200 drew 240 ma. at 1400 volts, which was approximately the current of the final, with *zero* bias. This looks like too much dissipation, but it takes quite a while for the tube plate to get red under these conditions and under talking or CW conditions it works fine. The next problem is supplying additional bias as the final draws more and more current. This

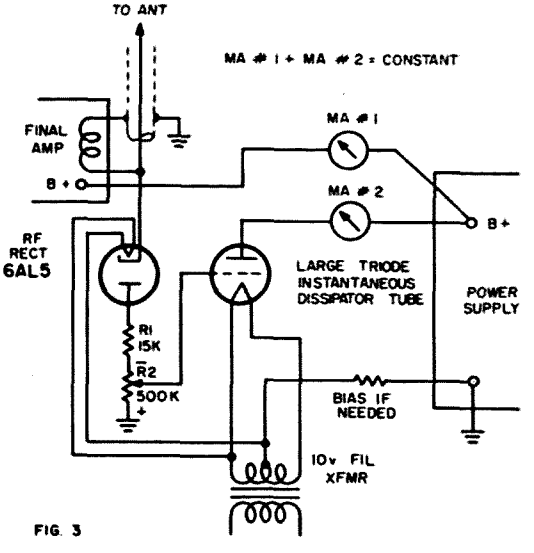


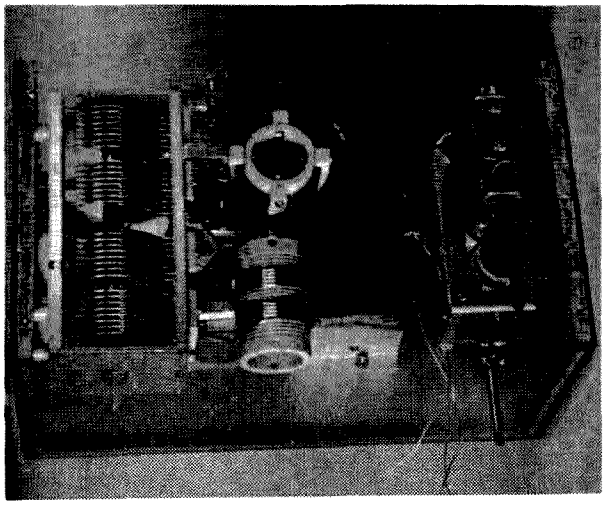
FIG. 3

is accomplished by using a diode detector connected right to the final amplifier output as can be seen from Fig. 3. The 6AL5 furnishes a negative voltage proportional to the rf output of the amplifier. If the amplifier is operated at peak or CW output you can adjust the 500K pot R_2 so that the dissipator tube draws no current. (I actually run it at about 20 milliamps to improve linearity at intermediate points.)

The question arises, why not use a semiconductor instead of the 6AL5? I tried it and two troubles appeared. First, semiconductors in general were not designed to rectify 100 volts or so of *rf* and they heat up, causing the bias to drift badly. Secondly, between no load and full load the results are very nonlinear. In my case the current drawn from the power supply varied from 240 mils down to nearly 100 mils at the worst point. Using the 6AL5 with filament on one half of the 10 volt filament transformer I get a current differential of less than 30 mils in 240.

Using the system in Fig. 3, and the final later to be described I was able to get a voltage regulation of about 30 volts in 1400. This was observed by manually adjusting the excitation between zero plate current and maximum in the final. On SSB very little fluctuation of a voltmeter on the plate circuit can be observed.

Obviously the instantaneous dissipator tube may be used with any power supply. The fact



that it works this well with a voltage doubler circuit indicates it would work even better in a standard full wave supply. The advantages to the SSB man or CW man should be self evident.

The final amplifier is an integral part of this whole project as is the exciter. [1]. Although nothing startling has been developed in the final, some readers might be interested in what the foregoing power supply with instantaneous dissipator was working into. I had long wanted an all band medium powered final and had several WE-312A tubes at about the time National All Band Tuners became available at

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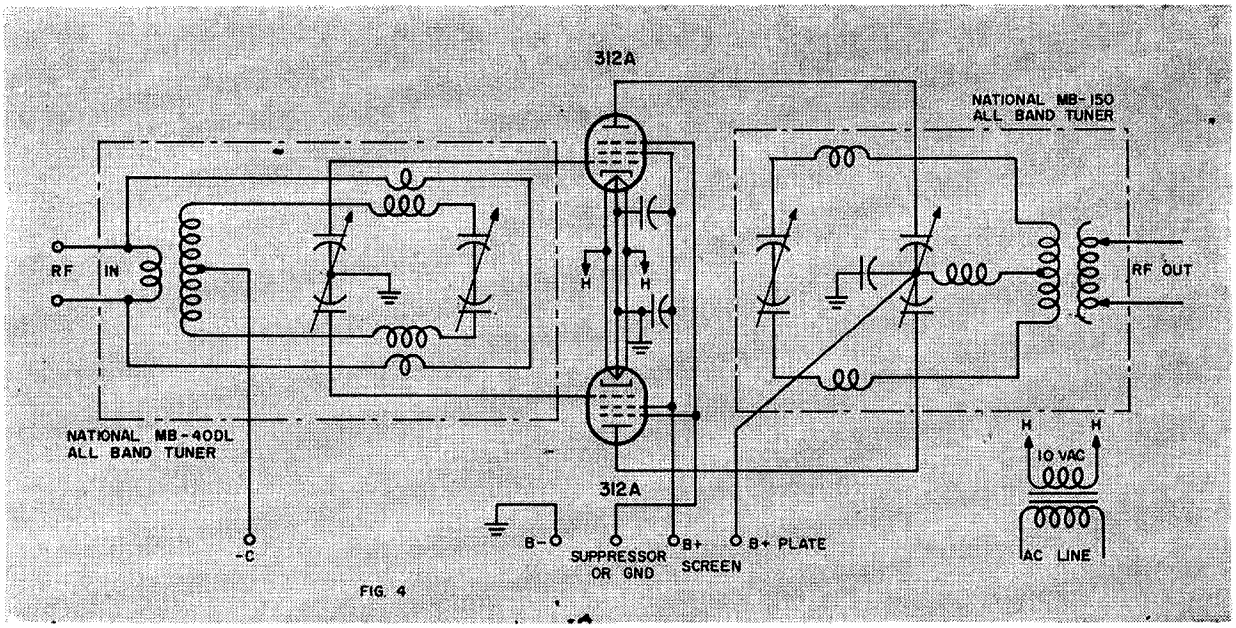
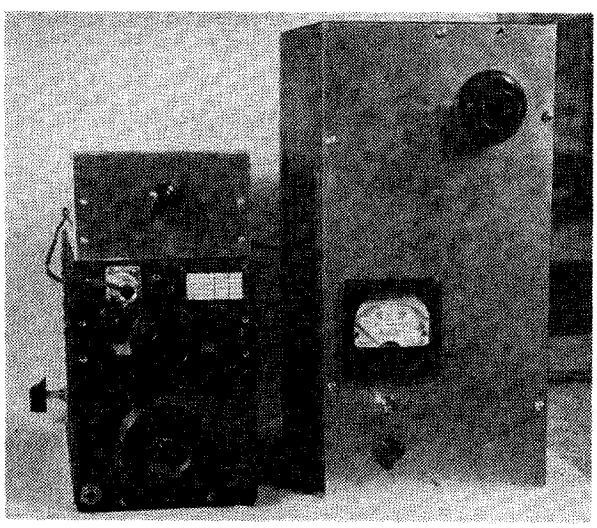


FIG. 4

bargain prices. This explains the reasons for the particular final here explained.

I followed the well known philosophy of hams, and sometimes I suspect even commercial manufacturers, of finding first a box and then designing the equipment to fit the box. I wound up with the grid circuit lying side ways in the bottom, the tubes mounted in an old GF-11 coil can, and the plate tuner hung upside down from the top of the can. The meter is a two scale 0 — 30 an 0 — 300 milliameter and not one that most people would be likely to have; so the circuit diagram is drawn with two meters. The circuit is straight forward push pull. It has no neutralization and no parisitic suppressors and so far works fine on 80, 40, 20, 15, and 10 meters. Maybe I was just lucky. 312A's have been available on the surplus market although 814's might be just as good. The 312A does have a suppressor grid and is a very fine suppressor grid modulated tube (handbooks rate them at 23 watts output or 46 for a pair). With suppressor grid modulation at 1500 volts I have been able to get about 65 watts out. The tubes show quite a bit of color, but otherwise work fine. On straight CW you can easily triple this. Peak power *in* on SSB can run about 400 watts. That assumes proper bias for a linear. The bias connections are brought out to the power supply so that any kind of bias may be used.



Though I do not yet own an SB-10, the proceeds from this article may make that possible. The SB-10 shown in the illustration was borowed from and with the experimental cooperation of W7VW. Experiments seem to bear out the fact that the exciter will adequately drive the SB-10 and that the SB-10 will adequately drive the final. Reports indicate the quality of the SSB to be definitely superior.

Although the method of using the instantaneous dissipator tube here outlined was for medium power, it would work equally well for the kilowatt final. More and larger dissipator tubes would be necessary. A whole string of surplus bottles of one kind or another would work. To those who still have a couple of 304TL's kicking around they would fill the bill excellently. What ever arrangement you can come up with it certainly pays off in better quality. . . . W7CSD

1. See article on exciter (What ever issue of the mag it may be)

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Management Directives

Roy Pafenberg W4WKM

MANY amateurs are employed in the electronics industry and assigned both technical and management responsibilities. Mountains of paperwork in both job areas generally prevent him from devoting full time and attention to purely technical matters. A very convenient aid to the proper understanding of obscurely worded technical literature has been published in 73 MAGAZINE[1] and this public service action has been the subject of many favorable comments.

Even more important to the practicing electroneer is the need to properly interpret management directives. In fact, his continued employment may very well depend on the correct interpretation and understanding of such writings. The following glossary should prove quite valuable in this respect and is printed here for the benefit of all 73 MAGAZINE subscribers whose continued employment and financial well being are of deep concern to 73 management:

As Written	Meaning
"A searching analysis reveals"	A spot check of incomplete reports.
"A survey is being made of this"	We need more time to think of an answer.
"Act at your discretion"	Go ahead, stick your neck out.
"Additional information received indicates"	Some of the reports were late.
"Additional information will be supplied at a later date"	Much later—after you ask for it again.
"Administrative oversight"	We goofed.
"All policies of the former management will remain in effect"	I haven't read them yet but will change them at the earliest opportunity.
"Attention is invited"	For Chrissakes, wake up!
"Authority is delegated"	If this thing works, I'll take the credit. If it flops, you get the blame.
"Budgetary considerations preclude"	No money.
"Expedite"	Compound confusion with commotion.
"For planning purposes, the following assumptions are made"	You are required to prepare firm and intelligent plans on a series of unfounded assumptions which will all be changed prior to the execution of your plans.
"Functional control"	You tell him what to do and he'll tell you where to go.
"Give us the benefit of your present thinking"	We'll listen as long as it doesn't interfere with what we've already decided to do.
"Growing body of opinion"	Two company officials agree.
"In due course"	Never.
"Information available in this office indicates"	This is the first inkling we've had but we'll take a guess.
"It is suggested"	Things would be different around here if I had anything to say about it.
"It is the policy of this company"	No reason for it. It's just our policy.
"It will be remembered"	You have forgotten, if indeed you ever knew.
"Let's get together on this"	I'm assuming you're as confused as I am.
"Note and initial"	Let's spread the responsibility for this.

"On an 'austerity' basis"	No materials.
"Opinion widely held"	Three company officials agree.
"Overriding priority is assigned"	We should have written this six months ago.
"Pending results of a survey now in progress"	We are trying to hire a man to make the survey.
"Present indications are"	One wild guess is as good as another.
"Program"	Any assignment that can't be completed by one phone call.
"Project"	Any assignment the office boy can't complete by one phone call.
"Research"	Dragging data out of an inaccessible place, tabulating it and then filing it in an equally inaccessible place.
"Research work"	Hunting for the guy who moved the files.
"Results, not methods, are what count most"	The greatest reversal since Serutan.
"Returned for reconsideration"	Did you think you'd get away with this one?
"See me and let's discuss"	Come down to my office, I'm lonesome.
"Status quo"	The mess we're in.
"This office is concerned with"	Knock it off. We're wise to you at last.
"Under active consideration"	Will have a shot at the files and see if we can find it.
"Under consideration"	Never heard of it.
"Within the framework of current instructions"	I don't know what they are. You look them up.

W4WKM

1 "How To Read What The PhD Writes," K5JKX/6, March '61, 73 MAGAZINE.
EDITORS NOTE: The author and your editor have devoted considerable time and effort in attempting to identify the anonymous writer of the source document from which this glossary was developed. Evidence points toward a still unidentified, itinerant Navy Officer. This Officer was stationed in the Philippine Islands several years ago but has been presumed lost at sea since the date the document came to the attention of the Navy Department.

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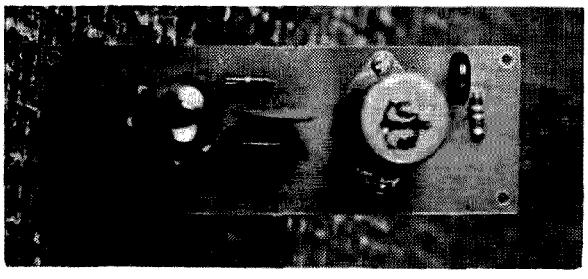
The American Cancer Society

A CW Man's Monitor

Don Wherry W6EUM
2121 Grandview Drive
Camarillo, California

FOR those of us who use CW, some kind of a keying monitor is a must, particularly so if we are using high power, which invariably blocks the receiver. Even with low power it is not always convenient to use your receiver as a monitor, and to send intelligent code with an automatic key without hearing what you are doing is next to impossible.

During the past years many types of such keying monitors have been described, using everything from batteries to rf energy for oscillator power. The unit to be described here (Fig. 1) is an AC powered monitor and probably is the simplest which can be built and still furnish a good positively keyed tone. The only prerequisite to its use is that you have a transmitter which uses a negative voltage to block off one or more of its tubes when the key is up. Transmitters of this type, which include a large percentage of the commercial types and most of the kits and home construction, bring out a negative grid blocking voltage to the key which, when depressed, grounds out the blocking bias, removing it from the tubes concerned and allowing normal operation of the transmitter.



The monitor unit shown in Fig. 1 (schematic in Fig. 2) uses this negative voltage to key a 6C4 oscillator tube in a transformer coupled feedback circuit, oscillating at some desired audio frequency. The monitor is keyed in step with the transmitter by connecting the normally grounded end of its grid resistor to the hot side of the transmitter key. This means that, when the key is up, the normal grid blocking voltage of the transmitter is also applied to the grid of the oscillator tube, thus cutting off the monitor's oscillations. When the key is closed the transmitter grid blocking voltage is grounded thereby removing it from the monitor and grounding the oscillator grid in the normal manner which allows oscillation to start.

One of the problems connected with such a monitor keying system is that of time delays in the blocking voltage build-up. These delays are built into the transmitter circuit to allow proper sequence keying and usually show up at the key as a slow voltage build-up when the key is opened. This feature will cause "tails" to appear on the monitor keying, sometimes to a prohibitive extent and always to an annoying extent. This characteristic is avoided in this monitor by the action of the oscillator tube itself. By using an oscillator circuit such as this, the feedback is very heavy, causing a large grid excitation signal and a large bias voltage to develop. This means that when the grid resistor is lifted from the direct ground by the opening of the key contacts the plate current of the 6C4 tube is rapidly cut off by the blocking action of the grid circuit. Before this grid blocking voltage can dissipate through the transmitter keying network the regular transmitter blocking voltage has built up and holds the monitor in a "outoff" condition until the key is again depressed. This allows good clean positive keying of the monitor. Another thing which should be considered before hooking a monitor onto the key of a transmitter using grid block keying is that you must not add a path from the "hot" side of the key to the ground. When the key is up, even though this path has a high resistance it will invariably upset the open key grid bias on your transmitting tubes and cause trouble.

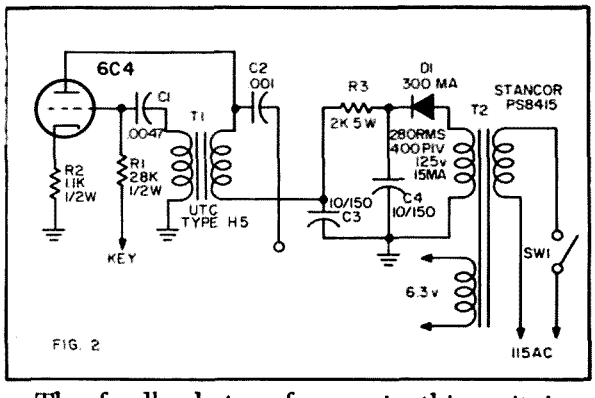


FIG. 2

The feedback transformer in this unit is a UTC miniature audio interstage type of the "H" series. The one shown in this unit is a surplus unit which I believe is identical to the commercial model H-5. Any audio transformer of the interstage type will operate in this circuit however so dig into your junk box.

The only thing to consider in this type of feedback circuit is the phasing of the audio

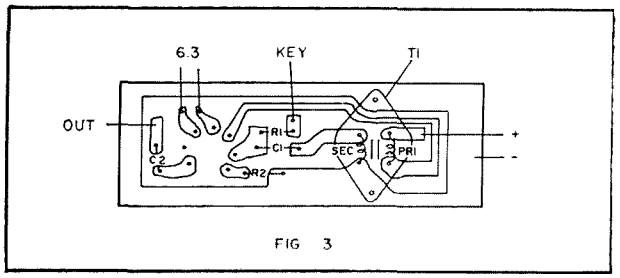


FIG 3

transformer winding. If the windings are not connected in the proper phase relationship the feedback voltage will be degenerative instead of regenerative, in which case no oscillations will be obtained. So if another transformer is used, be sure you know how it should be connected before you lay out your circuit board assembly.

The only adjustment which might be necessary to make to the oscillator is one to set the audio tone to suit the individual operator's taste. Lowering the capacity of C1 will raise the tone frequency and vica versa. This tone frequency can also be lowered by shunting a small capacitor across either winding of T1 or by decreasing the value of R1.

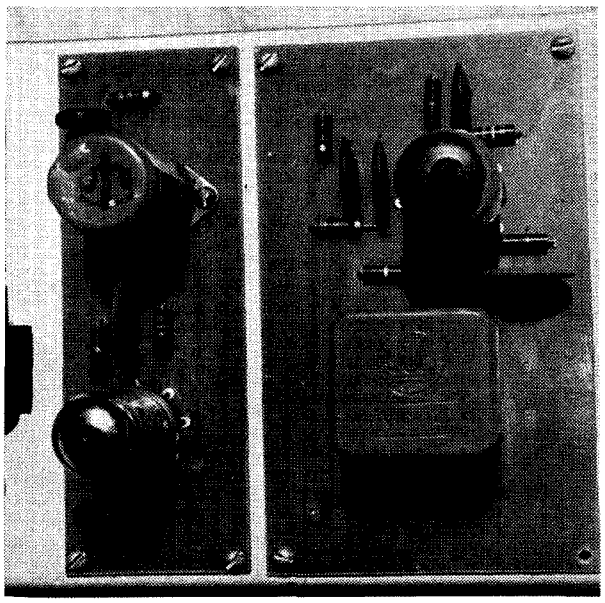
For headfone operation the output of the unit is mixed with the audio output of the receiver by paralleling the monitor output with that of the receiver. If the monitor is too loud, a resistor, or potentiometer, can be connected in series with C2 until the output level is of the correct value. In case it is desired to put the monitor on the receiver's speaker a small capacitor connected to the grid of the audio output will do the trick. Usually a few turns of wire twisted around the grid lead to the audio output tube will be enough capacity without a condenser, however.

The unit shown here is constructed on a printed circuit board, a layout of which is shown in Fig. 3. This is a "to scale" drawing and can be used as a template to trace on your board if you so desire. The handling of printed circuit boards has been described too often to repeat here. If you have any questions look back in past issues of your 73.

The power supply is normal, the only value which should be selected is that of R3. Select this resistor to give from 80 to 100 volts at C3.

In this installation the unit is mounted on a small chassis (Fig. 4) which also contains some antenna and transmitter controls along with a receiver output filter (see June issue of 73). Of course, it could be mounted as an integral unit on a small chassis of its own if so desired. By adding another stage of amplification, a standard volume control and one of these small miniature speakers it could be used as a monitor with no connections to the normal receiver output circuit at all.

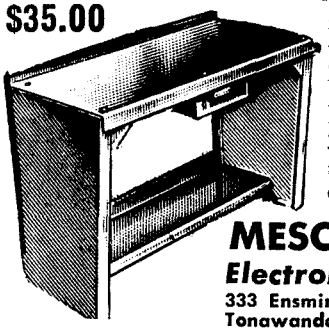
As a monitor it oscillates strongly, has a pleasing tone, rich in harmonics and keys beautifully. As mentioned it can be mounted in its own box which may be small and easily tucked away some place on your operating table out of the way if so desired. It is simple, cheap to build and above all it works, so if you're in need of a monitor, try it. . . . W6EUM



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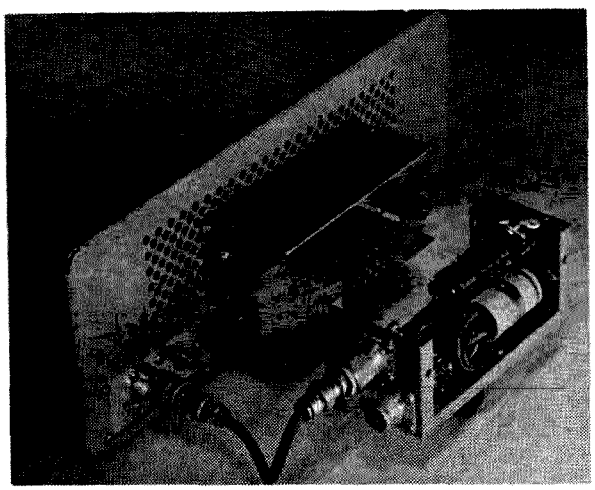
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Break-in and Push-to-talk for the Knight T-60

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photos: Morgan S. Gassman Jr.



THE Knight T-60 Transmitter has proven to be very popular as a first transmitter for the Novice and many are now on the air throughout the country. While this Allied Radio kit meets the requirements of the newcomer admirably, the phone operator and the more experienced CW operator will find manual switching from send to stand-by condition a trifle inconvenient. The convenience and efficiency of push-to-talk phone and break-in CW operation cannot be argued. Fortunately, the Knight T-60 is so wired and constructed as to make post-assembly installation of these features a snap.

Amateur literature was searched for a suitable circuit with the desired simplicity and which could be adapted to the T-60. No circuit could be found which was entirely satisfactory from the standpoint of transmitter changes required. After considerable experimentation, the basic circuit shown in Fig. 1 was devised and it works like a charm. The circuit is directly applicable to many commercial transmitters and offers several advantages in home constructed equipment.

The relay is a sensitive, high resistance unit with the series resistor selected to provide the rated relay current. When the key is closed, there is a slight delay while the shunt capacitor charges and the relay then operates. The relay contacts mute the receiver, switch the antenna from the receiver to the transmitter and complete the cathode keying circuit. The relay contacts are adjusted to make in the order stated to minimize receiver switching noise and to insure that the transmitter is not keyed until the antenna is transferred. Each key closure recharges the capacitor and this charge holds the relay closed during the normal intervals between characters and words. The diode passes the cathode current to ground but isolates the circuits so that, once the relay is closed, current from B+ to the floating cathode circuit will not hold the relay closed.

The salient features and circuit details of the Knight T-60 Transmitter were discussed in the original article[1] and only the circuitry affected by the modification will be treated here. Actual modification of the T-60 proper is very minor and consists of installing a three conductor mike jack, conversion of the external transmit-receive switching from ac to dry contact and removal of one resistor in the keying circuit. The relay and other components required in the break-in circuit are installed in a small metal case secured to the rear of the transmitter. All required circuit points already appear at the T-60 accessory socket and a short cable is used to interconnect the units.

Fig. 2 shows the changes in the transmitter proper. Remove the transmitter from the cabinet and locate J3, the mike connector. Carefully unsolder the two resistors, R8 and R9, from J3 and fold them out of the way. Remove and retain the mounting hardware and discard the connector. Ream the center hole to ⅜" and remove the burrs, being careful to keep the filings out of the chassis wiring. Reinstall the mounting screws, cutting them off flush with the nuts. Install a Switchcraft S-13B

[1] "73 TESTS THE KNIGHT T-60 TRANSMITTER," W4WKM, MARCH, 1962, 73 MAGAZINE.

jack in the ⅜" hole, leaving the mounting nut loose until the wiring is completed.

Carefully remove and retain R7 which is connected between Pins 1 and 3 of J1, the key jack. Unsolder the bare ground lead from Pins 1 and 2 of J1 and route directly to Pin 1, leaving Pin 2 vacant. Solder an insulated lead to this lug and solder the other end to the tip contact of the new jack. Connect, but do not solder, a bare lead between the sleeve and shorting switch contacts of the new jack. Connect the free end of R8 to the ring contact and the free end of R9 to the sleeve contact and solder all connections on the jack. Turn the jack as required to avoid shorts and to present a neat appearance and tighten the mounting nut.

The new mike jack accepts the PL-68 type plug which has the third contact for push-to-talk operation. The push-to-talk circuit of the mike jack and the key jack have been wired in series and, with neither plug inserted, the keying circuit is closed. When a plug is inserted in either jack, grounding the tip contact will complete the circuit. R7 has been removed to avoid conflict with the relay circuit and will be relocated in the add-on unit. Normal operation of the transmitter is possible except that the open key contacts are at an uncomfortable and possibly dangerous potential. Connect power to the transmitter and check for normal operation.

The next step is to convert the external control circuit from 115 volt ac to dry contact switching as shown in Fig. 2. Unsolder the gray lead from Pin 8 of J2, the accessory socket, and pull free to where it terminates on Terminal 3 of TS-2. Clip this lead close to the terminal and discard. Clip, from Terminal 2 of TS4, the white with red tracer lead which runs to Terminal 2 of SW2. Route this lead to J2 and solder to Pin 8. This completes the transmitter wiring changes by connecting the stand-by switch contacts between Pins 7 and 8 of J2.

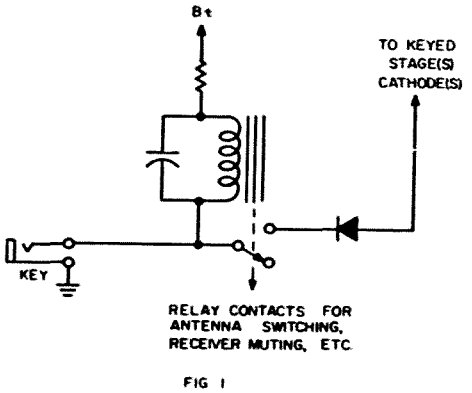
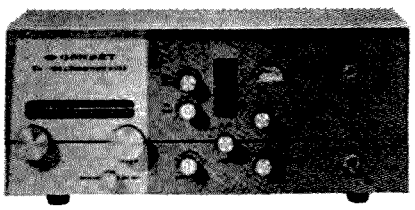


Fig. 1 This basic break-in keying circuit has application in other equipment. The capacitor across the relay charges when the key is closed and holds the transmitter on during the intervals between characters and words. The diode provides isolation between the relay and cathode circuits.



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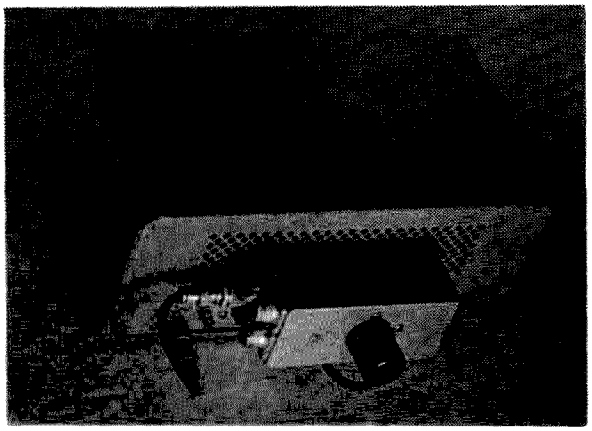
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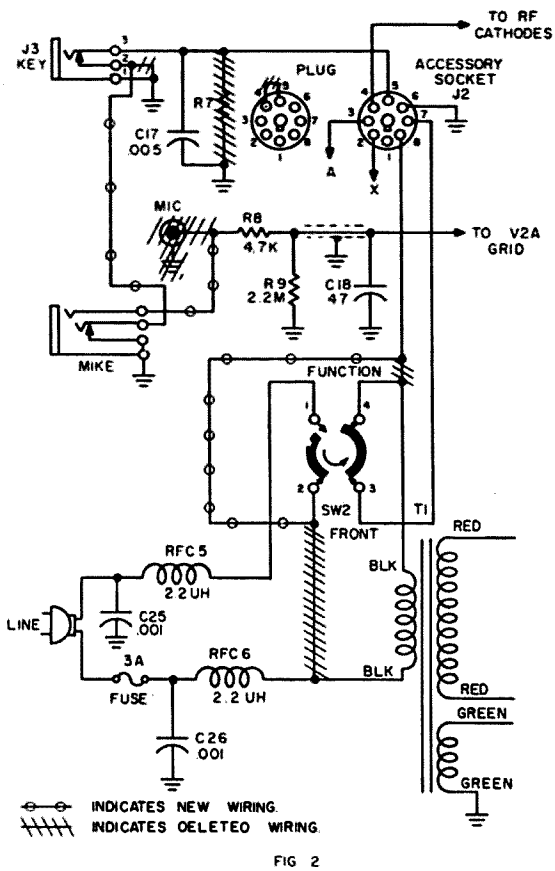


FIG 2

Fig. 2 Only minor wiring changes are required in the transmitter proper. A new mike jack is installed and ac is removed from the external control switch circuit.

The balance of the break-in circuit, shown in Figure 3, is housed in a small box secured to the rear of the transmitter cabinet. A Premier type PMC-1004 miniature aluminum case, measuring 5" x 2¼" x 2¼", was used in the prototype. Using short screws and nuts, mount the box cover to the back of the transmitter cabinet and reinstall the transmitter. The photograph shows the location and method of mounting.

The circuit in Fig. 3 is essentially that of Fig. 1, with the rf bypass capacitors and additional relay contacts accounting for most of the increased complexity. One added feature is the voltage regulator tube. This tube fires in the open key condition, holding the voltage across the key contacts to a safe 150 volts. When the key is closed, the voltage at Pin 5 of the OA2 drops to below 150 volts and the tube is extinguished.

Considerable latitude exists in the selection of components. The heart of the system is, of course, the control relay, K101. The unit used in the prototype is a Potter & Brumfield type KCP14, a 3 pole relay with a 10,000 ohm coil. The plastic case is discarded in this application. This relay was selected since it has large contacts with adequate spacing, good sensitivity and is reasonable in cost. With the Potter & Brumfield relay, a 40 mfd, 150 volt capacitor as C101 provided a delay compatible with the normal range of keying speeds. Relay characteristics affect the drop out delay and thus the value of C101. If in doubt, and a stock of various value capacitors is not available, purchase a multiple section unit such as a 40-40-40 mfd at 150 volt capacitor and use as many sections as required to achieve the desired delay.

Assembly of the unit is not difficult and no problems should be encountered. Install the 3 coaxial fittings of your choice on one end of the box. Remove the relay from the plastic case and position for the shortest leads to the coaxial connectors. The common contact leads of the 3 relay sections pass through holes in the contact terminal board and are soldered directly to the relay plug. Insert eyelets in these holes and solder the leads to these terminals. Now is the time to check the relay contact adjustment. Move the relay armature through its travel and observe the contacts.

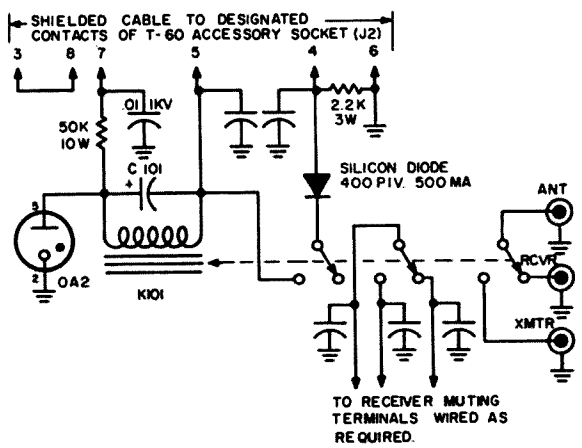


FIG. 3

Fig. 3 The circuitry shown here is housed in the utility box secured to the back of the transmitter. The circuit is essentially that shown in Figure 1 except for the voltage regulator which is required to reduce the voltage across the open key to a safe value.

Notes: See text for discussion on value of C101. All other unmarked capacitors are .001 mfd disk ceramic units. K101 is 10,000 ohm 3 pole relay. See text for discussion. Rf conectors are UHF type SO-239. Transmitter cable and receiver muting connectors were octal sockets in the prototype with extra terminals used as tie points.

Carefully adjust, by bending the stationary contacts, so that the receiver muting, antenna switching and keying contacts make in the order and break in the reverse order indicated.

Some may object to the use of this type relay in an rf switching application. However, the contact spacing, relay insulation and contact size are adequate for the power levels employed in the T-60 if the normal precautions are observed. Never operate the transmitter without an antenna and be certain of the relay contact operating sequence before power is applied.

The balance of the components may now be mounted, keeping them as far removed from the relay and rf wiring as possible. The photograph shows the details and this layout is suggested. Octal sockets are used for the T-60 cable and the receiver muting connectors, with the unused terminal lugs employed as tie points for other parts. The OA2 tube socket is mounted on stand-off posts as shown. Complete the metal work, mount the components and wire as shown in Fig. 3. The rf bypass capacitors should be wired, with short leads, directly to the socket terminals and ground saddle.

Remove the jumper between Pins 4 and 5 of the accessory socket plug and install the jumper between Pins 3 and 8. Use the plug and a second similar plug to make up the cable which connects the break-in unit to the transmitter. The photographs and Fig. 3 give the details. Install this cable and a short coaxial cable between the T-60 ANTENNA and the break-in unit TRANSMITTER coaxial connectors. Connect a 100 watt lamp to the ANTENNA connector and a neon lamp to the RECEIVER connector.

Switch the T-60 to STANDBY and connect power. Install a crystal and plug in an open key. Switch the transmitter to TUNE and obseve the OA2 VR tube which should glow blue between the elements. Close the key and, after a momentary delay, the relay should operate. Tune the transmitter normally, switching to CW to complete the tuning. The lamp load should light when the transmitter is tuned properly. Open the key and, after a delay of a second or so, the relay should release. Send a test with the key at your normal operating speed. The relay should close after a slight delay and remain closed between characters and words. Increase the value of C101 if the relay delay is insufficient. Check to see that the neon lamp does not light at any time. If the lamp flashes it indicates that rf would be applied to the receiver input and that the relay contact switching sequence requires adjustment as previously described.

Remove the key, plug in a high impedance microphone with push-to-talk switch and switch the T-60 to AM. Operate the mike switch and the relay should close and remain closed for a second or so after the switch is released. When the unit is operating to your satisfaction, remove the lamps and secure the box to the cover mounted on the transmitter. Connect the antenna to the ANTENNA connector of the break-in unit and install a cable between the RECEIVER connector and the station receiver. Wire in the receiver muting contacts as dictated by the receiver standby or muting switching requirements and you are ready to go on the air.

The convenience of having no controls to operate between the transmit and receive conditions must be experienced to be appreciated. The small cost and effort required to construct the break-in unit is well rewarded in operating pleasure. Such refinements as this make the difference between an expensive assemblage of hardware and a smoothly operating communications facility. . . . W4WKM

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Panel Markings

Jim Kyle K5JKX

AN interesting byproduct of the rise in "do-it-yourself" gear is the corresponding rise in interest in methods of making the finished product look "commercial." Within the past year, at least three different techniques for producing professional-looking dial plates and panel markings have been described in the literature; these techniques use methods borrowed from engineering-documentation practice, and can produce nameplates on either paper or metal.

However, they share two common drawbacks: the nameplate is limited in color to black and white, and the processes (unless expensive camera work is resorted to) produce only negative images.

Here's another, little-known technique which produces nameplates on clear plastic film, in your choice of 19 colors, and which can produce either negative or positive images (whichever you desire) with no camera work at all. Most of the materials are available at any well-stocked art supply firm; all are readily available across the country.

The basis of the technique is the diazo process, widely used in industry to produce "blueline" reproductions of engineering drawings. This is a completely dry process; it makes use of paper coated with a special material. This coating includes a diazonium salt, a "coupler," and a mild acid.

In the absence of the acid, the diazonium salt



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and the "coupler" combine to form a densely colored dye. Until the acid is removed, the coated stock has a pale yellowish cast.

To use this process, the coated paper is placed in firm contact with a translucent "master" containing opaque-line drawings, lettering, or other information, and is exposed to either sunlight or an arc lamp.

Where ultraviolet light passes through the "master," the diazonium salt is converted to an inert material; where the opaque lines block passage of light, the diazonium is left unchanged.

The exposed stock is then exposed once more, this time to ammonia fumes. These fumes neutralize the acid, allowing the dye image to form.

The process is known commercially by a number of names, including "Ozalid." As usually used, it produces blue lines.

However, the basic process is not limited to either blue lines or to the use of paper stock for the print. The Technifax Corporation, Holyoke, Mass., produces diazo sensitized stock on clear plastic film, in 10 dense and 9 pastel colors (including, in each case, black). This stock is known as "Diazochrome Foil." ("Diazochrome" is a registered trade mark of the Technifax Corporation.) This material is available from any of the firm's 51 branches throughout the country, and is the material used in this process.

To show how it works, let's take a comparatively simple example first. Let's suppose you're making a tuning dial for your new receiver; you would like to indicate, on the dial, if possible, the various sub-bands (phone, CW, Novice, etc.).

The first step, naturally, is to make a pencil rough by taping a piece of paper where the dial will be and marking calibration points, in pencil, on that paper.

Next, place the paper on a smooth surface and tape it in place. Then tape a sheet of tracing paper or "vellum" over the pencil rough. Using a compass and straightedge, trace the calibrations in ink. Make sure that all your lines are of equal density; uneven line weights will become obvious in later steps.

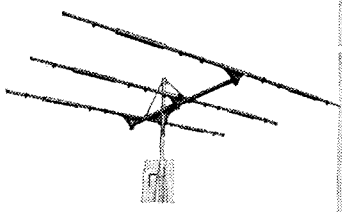
Now, working in subdued light (40-watt bulb or smaller, no direct sunlight or fluorescent), cut a piece of *black* Diazochrome foil to the same size as the dial plate. Keep track of the emulsion side of the foil when you cut; this is the side of the sheet which faces you when the

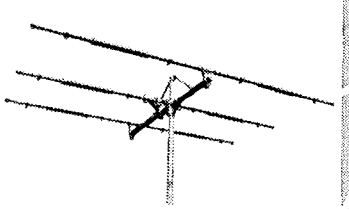
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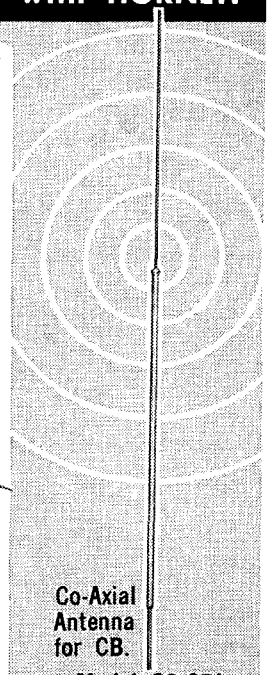
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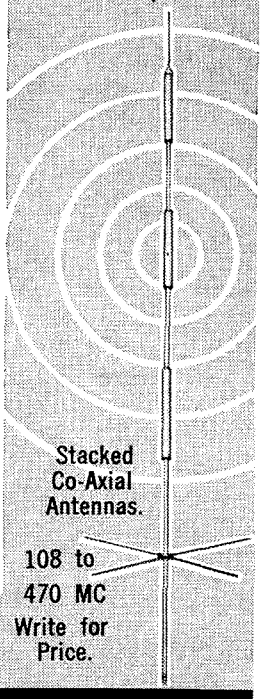

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notch is in the upper right-hand corner and on the top edge. Clamp the ink tracing you made in step two in contact with the foil, under glass. A picture frame, or better yet, a large photographic contact printing frame, is ideal. The tracing and foil must be in close contact.

At this point, expose the foil-and-tracing sandwich to direct sunlight for approximately one minute. Keep track of the exposure time by using a watch with a sweep-second hand, in case you have to make another print.

After exposing the foil, return to the subdued light and unclamp the sandwich. At this point, the foil should be completely transparent except where the ink lines shaded it; these lines should be pale yellow and barely visible.

Now, the foil is ready to be developed. Development is accomplished by exposing the foil to strong ammonia fumes; one of the best ways to do this at home is to get a large, wide-mouth glass jar, such as those used to pack pickles for commercial users (ask your favorite restaurant). In the bottom of the jar, place a sponge; on the sponge, put a few drops of commercial-strength ammonia (26%). Then roll the foil, emulsion side out, enough to get it into the jar and clamp on the lid. The image should appear within four to five minutes. When it stops getting darker, development is complete.

If the image is too light, you exposed the foil to sunlight too long. Repeat the process, exposing for only half as long as you did the first time. If it's too dark, you didn't expose long enough; double the exposure on the next try.

If all you wanted was a black-on-white dial, you would be nearly finished at this point. However, to indicate the sub-bands in color, a few more steps are necessary. The first is to either cut from the foil you just made, or trace on separate sheets of paper, the dial scale portion for each of the sub-bands. For instance, the "Novice" tracing would include only 3750-3800 kc, 7150-7200 kc, and the 21mc Novice band of 21,100-21,250 kc. If you cut these from the original foil, tape them down with Scotch No. 310 tape to a sheet of clear celluloid or acetate in their proper positions.

To check the tracings, sandwich them all together. When all are properly registered in the sandwich, it should look just like the plain black-and-white dial you already made. If it does, the register is good and you can proceed. If one or more fails to line up, re-do it until it does come into line.

Now, decide what colors you want to indicate what. For instance, you might like to have phone bands in green, Novice bands in red, CW in blue, and the kc markings and legends in black.

A tip at this point—to get the legends in black, they must appear on a separate tracing all by themselves, and must *not* appear on any other tracing.

With the four tracings needed for this example prepared, expose a sheet of the proper color of Diazochrome foil through each as you did before. Development also is identical to the procedure already described. You should come up with four foils, one bearing the Novice regions in red lines on a completely clear background, one bearing the phone bands in blue lines, one with CW bands in blue, and one black foil bearing only the numbers and letters you want on the dial.

Now, sandwich these four together so that the lines match properly, just as you did when checking the tracings earlier. It works best if you register two foils first, then tape them together and register the third on the taped pair, tape the third in place, and register and tape the fourth. Presto, a four-color dial.

At this point, of course, it's on a transparent background. You can cure this in either of two ways: you can back the sandwich up with a sheet of heavy white paper, or you can spray the back of the sandwich white with white spray enamel. Either works fine.

Of course, you're not limited to only four colors. A total of 19 different colors of foil are available, and you can use as many as you like. In addition, since the colors are transparent and the primary colors are included in the selection, you can blend colors by shading to produce any result you want.

Earlier, we said this technique made it possible for you to have either negative or positive dial plates without camera work, yet all we've mentioned so far is the positive plate (colored lines on white or clear background).

To get a negative dial, you proceed in the same manner except that you use a sheet of special "negative" Diazo foil; this material produces a reversed image, which will be clear lines on a colored background. It's available only in sepia, which prints like black, but the foil you get from it can then be used to produce dial plates in any color you desire.

The materials used are relatively inexpensive —a 4x10 inch dial in four colors costs only about 50¢ to make—but they are available only in comparatively large quantities. The smallest package available in Diazochrome foil contains 25 sheets of foil, each 8½ by 11 inches, and sells for $6. To get four colors, four pack-

DX-100 OWNERS

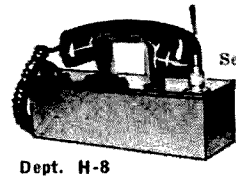
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ages would be required. However, each package would make 50 dial plates of the size mentioned earlier, so if you do much homebrewing, and especially if you can find several other hams also interested in the idea to help defray the initial expense, the cost becomes quite low. The only other item you might have difficulty locating, the commercial-grade ammonia, is available at most drug stores at very reasonable rates.

. . . . K5JKX

Novice VFO

Gary Huff K9AUB

ALTHOUGH FCC regulations specifically state that Novices shall control the frequency by crystal control, and VFO's are outlawed, it is still possible for a Novice to use crystal control and have limited control of his frequency as if he were using a VFO. The idea described here is not new, and has appeared in such commercial transmitters as the Lysco 600.

Basically, it consists of placing a coil and capacitor in series with the crystal. The coil-capacitor combination will "rubber" the crystal a few kilocycles above and many kilocycles below the normal resonant frequency of the crystal. Of course, this effect is greatly increased as the frequency is increased. A 15 meter crystal will "rubber" three times as far as a 40 meter crystal.

The circuit is actually a VFO in series with the crystal. The coil and capacitor may be built into the transmitter if space permits, or may be added externally in a small utility box. Construction is not too critical, and the same practice as one would use in building a VFO should be followed. Once it is determined how far a crystal will rubber and still oscillate, the Novice may purchase several crystals far enough apart so their frequencies will overlap, and quite a large segment of band may be covered.

A word of warning. With crystals close to the band edge, it is quite easy to rubber yourself right out of the band, so be extremely cautious in setting the crystal frequency so that you don't get caught outside the band.

. . . K9AUB

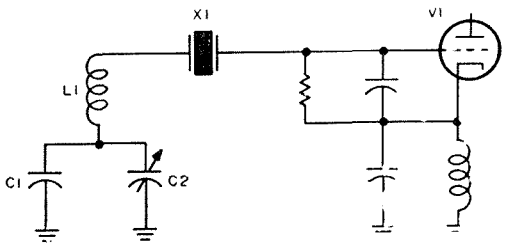
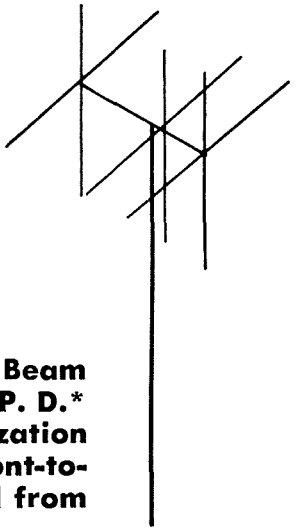


FIG 1

L1. . Conventional VFO coil to resonate at crystal frequency with C1 and C2.
X1. . Crystal
V1. . Present crystal oscillator tube in transmitter

for the

no-QSB QSO



***Space Raider* brings you the amazing *Polarized Diversity* Beam designed by K6CT and proven by DX men the world over. P. D.* virtually eliminates the 80% of QSB caused by polarization shift. P. D. Beams offer vastly improved forward gain, front-to-back and side rejection ratios. *Space Raider* beams priced from $44.50. Write for particulars.**

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Potato Face

Sylvia Margolis XYL-G3NMR

I OFTEN wonder which is worse—for a man to be downright ugly or a woman. My friend, Vera, could have told you, once.

I'd known Vera all her life. Her father and I grew up together. As kids we built our first crystal sets together, back in the very early days. We lived as neighbors and friends and, when I became President of our local radio club, he was one of my ablest Committee men. I've been President now for more years than I like to admit. Ours is a fine little club, with plenty of new members coming in each month but, although the Committee changes with the years, I like to think it is because I am a good President that they re-elect me each year, not because they know it would break my heart if they didn't.

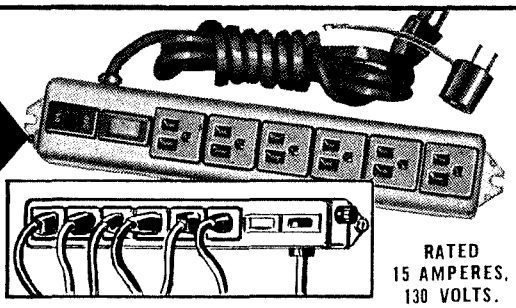
So I watched Vera grow up. Even as a child she was unattractive. Her elder brother and sister were homely enough kids but somehow Vera was just that much too plain. And from the beginning she knew it. It was heartbreaking to see the bitter truth twist her baby soul. At children's parties Vera was always the kid who was never chosen to take part in the games. She would sit them out with a wooden, uncaring expression, trying to show that it didn't matter really, while the other little girls, lovely in organza and ribbons and long white socks, quickly became the cruel teenagers who left Vera out of their invitation lists. At high-school parties Vera would spend the evening out in the yard, petting the host's dog, curled up into an ungainly lump of sensitive misery. At picnics it was Vera who could be relied on to look after the food efficiently. Nobody wanted to walk her by the river.

My own kids adored Vera, with her big, lumpy face, her thick clumsy body and sparse, mousy hair. A vicious neighbour named her "Potato Face" and Vera knew it, but that potato face could come alive when she was telling a bed-time story, or comforting a fretful child.

Hers was a lonely life and perhaps it was lucky that her job as schoolteacher so filled her working hours that the emptiness of her leisure could, with kindness, be called "relaxation." When she was twenty her parents died suddenly, within weeks of each other. I lost my best friend and I was left as a kind of unofficial guardian with his daughter. Her brother and sister had married and moved away, so Vera clung to my family and we always welcomed her into our full and boisterous home.

One Christmas Eve I stepped across the street to the old house where she now lived alone. It was lucky that my wife had sent me over with the invitation to Christmas Dinner the day before Christmas Day. Otherwise I would have been too late and Vera would have finished the job. As it was I was just in time to drag her out of the gas-filled room. I called a medico friend whom I knew to be discreet and there was no scandal. When the fuss was all over my wife and I were faced with a problem. It was no easy task to persuade Vera to re-enter the utterly empty and lusterless life which she had tried to quit. Then I thought of amateur radio and suggested that she take up her father's life-long hobby. At first she was unresponsive and cynical, but her quick brain soon mastered the essentials and bit by bit her interest was aroused. Within a year she was on the air. We put together a real fine station for her, using some of her father's old gear and some of the new commercial equipment which she insisted on buying because, as she said, what else was there to spend her money on? Some of the club boys helped me fix up a good high beam, for this was our first local lady amateur.

Ours is a wonderful hobby for lonely people and it made all the difference to Vera. Now

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it no longer mattered that she was left out of the skating parties, the moonlight barbecues, the dances that the other young people organized. There would always be a contest or a schedule to fill the gap. Gradually the current set of young people became younger and younger and Vera was beyond it all, an old maid of thirty, who had never been anything else. School filled her days—Vera was a marvellous teacher—and radio her nights.

It was the DX she liked best. I think she was always afraid to get involved in local nets for fear that the QSO's would lead to personal meetings, with the inevitable let-down and mumbled politeness and practised sliding-away that she had come to know so well. So Vera made friends in Athens and Leningrad and Paris, where the operators were not to know that the YL with the rather lovely voice and the charming mike manner was the more-than-homely butt of our little town, Fat Potato-Face, on whom the gathering years made no improvement. Vera never put her picture on her QSL's—no sir—but she did learn to flirt gently over the air with men she would never meet.

Her first contact with Harry was quite casual—a dead band, a venturous CQ and straightway back came a W1—the only one around, it seemed, crisp and clear, with no QRM, as if some ionospheric Cupid were putting in overtime that night. It started off as a rubber-stamp QSO—callsigns, reports, QTH, WX, run-down on the rig. But when all that was over the band was still miraculously clear. Each was attracted by the other's voice—Harry's was deep, with a New England twang. So they began to gossip a little, shyly and awkwardly at first, but with neither wanting to end the contact.

She told him she taught school in Ipswich. He replied that he came from Vermont, but was living and working as a sound engineer in Boston, which might be a big city, but was certainly the lonely, and what a blessing amateur radio was. Then up came the QRN and it was with something like panic that Vera lost contact. But the next night there he was again and seemed delighted to hear her once more. This time they discussed antenna systems and she helped him make some comparative tests, then they began to talk a little about their own lives. He told her about his dog and she agreed that dogs were nice things to have about the house. Then they discovered a mutual love for serious music. He described a recent concert he had heard at Boston's Symphony Hall. He had been told by an Englishman—no less—that this was the finest concert hall in the world.

Somehow after that it seemed natural for Vera to listen out for her new American friend. A regular schedule developed, but then, with the advent of Summer, the band went out. Regretfully Vera came up once more to the surface of life and didn't like it one bit. Normally most reserved and reticent, she took a chance on a letter to Harry. Life had accustomed her to personal hurt and rebuff but still she was bitterly disappointed when weeks passed before he replied, then his letter was a brief, stilted, type-written note. She didn't write again. But that Fall there was Harry again and apparently overjoyed to renew the friendship.

Vera seemed to blossom in the winter months that followed. She remained the fine and conscientious teacher she had always been, but little else in her existence had any substance. All that were real and tangible were the shack and the precious magic hours in contact with Boston. At Christmas Vera had to excuse herself early from our dinner table to keep their Christmas-Day schedule. She was so very proud to have to do this—to have a real date with a real beau, even though he be three thousand miles away. Harry was unmarried and over forty and to her he was everything.

(Turn to page 69)

(Potato Face from page 67)

Forgotten were the misery and humiliation of childhood and adolescence, the feeling of not mattering to anybody. She proudly showed us the get-well card he sent when she was sick. It stood on her dresser for weeks.

One day in the Spring she rushed into our house to sob incoherently that it was all over. We calmed her down a little and she told us that Harry was to visit from the States. My wife and I were too intimate with her to make any pretence of how nice that would be. There was a sense of catastrophe. I suddenly remembered that dreadful Christmas Eve long ago and the reek of gas and how I had been just in time.

"I'll take a vacation—I'll go away!" she moaned and burst into tears again, thick blubbering ugly sounds. Few women can cry prettily and poor Vera's plain face had never seemed so unlovely. She showed me the short letter. Harry's firm was sending him to London for a month to study some new techniques in sound reproduction. He was looking forward very much to that personal QSO.

There was no way out. It just had to be. Vera, who had always had a raw deal from life, was all prepared for yet another blow. How could it have lasted? Who was she to expect her fool's paradise to go on forever?

The next weeks were shocking. She went to a

(Turn to page 70)

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Some people might wonder what we've been doing. We certainly haven't been able to answer all your letters; we haven't done any advertising lately; we've passed up some hamfests we had planned to visit.

It just happens that we *don't* think that amateurs should have to pay for serving as guinea pigs for new products. We *do* think that an investment should be as safe as possible. We didn't want to bring out a model which might have to be improved in just a few months, simply because we might have been in a hurry or may have overlooked something.
So, we've been busy.

WE'VE:
tested units under almost ridiculous environmental extremes;
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and managed to make some truly significant improvements in the whole system—things like increasing the power of our DT20 SSB transmitter, and improving the sensitivity of the DR30 receiver, and adding 6-meter coverage (some people say this is downright revolutionary: VHF coverage without external converters), and still more.

Two and a half years of development is a long time. We're proud of the results, though, and think that you'll agree with us that the time has been worth it.
Thanks for being so patient!

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The DR30: a double conversion ham-band receiver with mechanical filter selectivity, superlative performance, excellent stability, and features not found in other units at any price. It costs $289.50 complete with all crystals, etc. The matching DT20 SSB-AM-CW transmitter-exciter is available in two models: the DT20A for independent use at $345.00 including power supply, and the DT20, which shares xtal oscillators and mechanical filter with the DR30 receiver and is designed for use with it, when it provides all functions of the DT20A including separate VFO's or transceive operation ($215.00 including power supply). Each unit is 7½x4x5 inches. All are imminently suited for fixed, portable and mobile operation by the most demanding amateurs and are wired, tested, and fully guaranteed.

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(Potato Face from page 69)

beautician and came away with her eyebrows a different shape and her lank hair corrugated into unfamiliar curls which somehow seemed to accentuate all the more her homeliness. She lost weight with worry, but her great heavy body seemed the same uncompromising gawky mass it had always been. We never left her alone. My wife even took a trip to stay with a friend, so that we should have an excuse to ask Vera to come over and run our home for a week, for then she would have no time to herself.

The dreaded day arrived. Vera begged me to meet Harry at the plane, for she couldn't face the horrifying meeting in the public arena of an airport lounge. I have had few minutes more soul-searing than those watching the big plane scream to a halt and waiting to meet the visitor. The little knot of passengers came across to the lounge and then I saw Harry.

I knew all at once a great surge of triumph and joy and sadness and pity for the whole human predicament. I greeted him, then, while he was checking his baggage, I excused myself to rush to a phone and call Vera.

I just had to tell her about Harry's white stick.

(W2NSD from page 4)

VHF Publications

There are now three offset printed bulletins catering to the VHF enthusiast, all leaning heavily on station activity reports. The newest, scheduled for a May debut and now reported to be out, is published by CB Horizons in Oklahoma City. I'll have more info on this when I get a copy. The editor is erstwhile 73 author Jim Kyle K5JKX. The oldest bulletin is VHF Amateur published by K2ZSQ. Bob pulled a sneak attack on Horizons by using the Horizon cover logo from their prepublication hoopla and making his latest issue look just exactly like the expected bulletin from Horizons. One of the bulletins that you Technicians should be sure to support is "The Technician" published by Armond Nebel K7MFA, Box 465, Billings, Montana at $2 per year. This is a friendly and interesting bulletin.

Citizens Band

Bah!

I knew no good would come of that darn thing. Now I keep hearing more and more talk of their expanding the CB into our ten meter band, or maybe into the top half of six. This is ridiculous. I know, I know, they're

crowded and need more than 22 channels. If they'd cut out all the monkey business and get the frustrated would-be hams off the CB channels they would probably eliminate most of their QRM problems. Some fellows have suggested a new ham ticket for these chaps which would allow them into our VHF bands with no code and little technical requirements, which license would serve to ease the strain on the CB channels and keep our VHF bands busy enough to fend off raids from neighboring services.

The proposed encroachment on ten meters is based upon our non-activity in this region as much as it is on the overcrowding of the eleven meter Citizens Band. Why are we letting these frequencies go by the board? Why are we letting ourselves into another eleven meter situation again? With 250,000 hams in this country do you mean to tell me that we can't scare up a handful of fellows to keep these bands alive? Rats.

For example, Brooklyn probably has a ham population on the order of 7000 licensed amateurs. Still, if I tune across ten meters any evening, I am lucky to hear two or three QSO's in progress. Many times all is silent. A ten meter antenna is simple and all of the all-band rigs work fine there, so where is everyone? Probably watching TV after an unsuccessful battle with the QRM on 75. I don't suppose that there is any way to get fellows to invest a half hour a day in the preservation of our bands. If the 7000 hams in Brooklyn would each devote a half hour a day to getting on one of the "unoccupied" bands there would be so much activity that no one would think of taking away our frequencies.

How about it? Will you take a few minutes a day to keep the wolf from our door? Just get fired up on ten now and then, get something going on two this weekend and lure fellows up to the upper end, and once you've gotten set up on these then see what you can do to set up some nets in the high end of six meters. You don't have to blast away at the bands with a KW to have fun, a simple Sixer, Tenner or Twoer will do it, as will any of the many simple rigs we have run in 73 or that you will find in the Radio Handbook or the ARRL Handbook.

Reciprocation

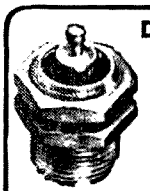
Senator Magnuson will be holding hearings on the Reciprocal Licensing Bill in the near

(Turn to page 72)

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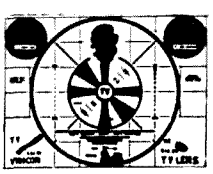
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(W2NSD from page 71)

future. If you have anything cogent to say in the behalf of this bill you might make it your business to find out just when the hearings will be and be there. If you haven't anything cogent to say in behalf of this bill then you haven't been paying much attention to what is going on. Let's keep the Senator busy fellows. You can bet that I am going to make it my business to get down there and I want to see that place jammed with hams.

Conventions

This changing of QTH's is taking so much of my time that it is impossible for me to get around to any conventions or hamfests this year. Even if I had the time there is the financial strain since conventions just do not bring in enough in subscriptions to pay for themselves. It is a lot of fun putting out a ham magazine the way I think it should be published, but I do have to keep one eye on the till. Maybe by next year we will be doing well enough so Virginia and I can get to some more hamfests.

Advertised Products

For some reason known only to yourself you are continuing to buy products that are not advertised in 73. Thusly encouraged, these manufacturers continue to not advertise in 73 and we continue to have to raise our subscription rates in order to meet the increasing bill from our printers and the post office. Just a few more pages a month of ads and we wouldn't have to raise our rates. I don't expect you all to sit down and write angry letters to non-advertisers, but you might chide them at the next convention and add it to any correspondence that you may have with them. You might take a quick look through the magazine and notice those major manufacturers who are obviously missing.

Don't forget us on the 19th. Come on up for a visit to beautiful New Hampshire in the famous Monadnock Region. Bring some VHF gear and try out Mount Pack Monadnock, just five minutes from our house. It is reachable by car and is one of the most popular VHF contest spots in the country. Where is Peterborough? About midway across the state and just above Massachusetts.

Wayne

SUBSCRIPTIONS

Whether you buy 73 on the newsstand, at your local parts distributor, or wherever, you really should be subscribed. Not only do you save a bit of money and are assured that you will get your copy each month, but also it will make us all very happy and might even leave a copy at your supplier for someone else to discover the magazine. You want us to be happy in our new headquarters, don't you? By the way, our sub rates will have to go up soon and we may not give you much warning.

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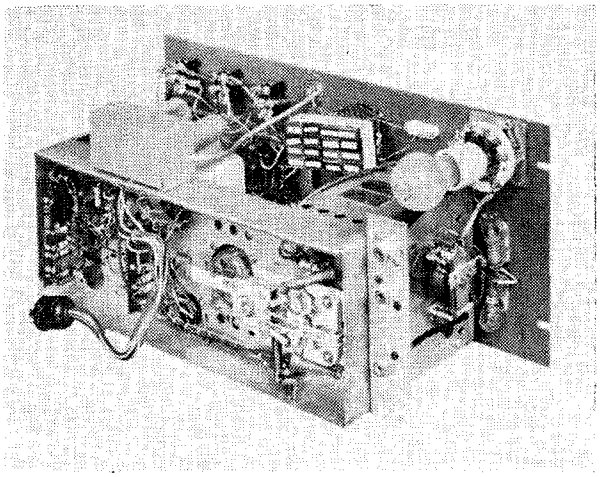
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a 522 I had to figure some way to mount it that wouldn't take up any desk space. The result, Armchair Console, the unit stands to the left of the operators chair against the wall in front of the desk. By mounting the panel "Upside down" in the cabinet and making aluminum angle legs, I have a drop front cabinet that makes access to tubes a real snap. The conversion is the usual as done in the Conversion manuals, with the exception of the Quartz VFO, a surplus 16 position switch with 16 of the most used frequencies hereabouts. I have an antenna relay and ant. selector switch incorporated. A conventional 12AU7 mike pre amp completes the rig. The power supply is made from scavenged TV's, and a surplus xformer. All parts including cabinet ($2), are surplus or junk box with the exception of the rack panel and vernier dials. Total investment about $20, input 20 Watts. I have photographed it both vertical and horizontally mounted. I hope you can use some of it. I think the Armchair Console, idea may prove as handy to other crowded shacks as it did to mine.

Also included is my QSL, also home brew. I have had real good luck on returns using this type. With all the Amateur Photogs that are also Hams there should be more of this type of card. Need an article? The big drawback to cards of this type for hams who like to build and modify, is that they go out of date and have to be redone every few months. I now have a Drake 2-B between the Viking and the Knight, and the Homebrew keyer, and



preselector are on top of each other, and I'm using the Knight for an I-F with a H. B. Nuvistor converter on 2. New card coming up soon. Vocation here is commercial photographer. I sure like the magazine Wayne, don't change a thing unless you make it bigger and more technical-builder type.

. . . Dick Giffen WA6MLI

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A Surplus Motor Driven Coaxial Switch

Roy Pafenberg W4WKM
316 Stratford Avenue
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Photographs by Morgan Gassman, Jr.

A NUMBER of motor driven coaxial switches have appeared on the surplus market in recent years. Of these, the SA-325/U is typical in design and construction. The switch is a 4 position unit, designed for remote operation from the usual 28 volt dc aircraft supply. Except for the dc voltage requirement and the lack of technical information, these units are ideal for amateur application.

This article is designed to solve both of these problems. Fig. 1 shows the schematic diagram of the SA-325/U RF Coaxial Switch. Negative battery is supplied to Pin "A" of the connector and positive battery is supplied to one of the Pins, "B" through "E". The motor turns the switch sections and the rf switch unit until the open switch segment reaches the stator contact used to supply positive battery. The motor then stops and the rf switch rests in the selected position. This "open seeking" type of remote positioning is a very simple servo system that is widely used. Its major disadvantage is that one control lead is required for each switch position.

To prevent overtravel of the rf switch, a braking winding and commutator are used in the small PM drive motor. The rf switch mechanism is coupled to the gear drive by a loose fitting yoke. The rf switch is equipped with a strong detent which, as each position is approached, causes it to overtravel the motor drive. At the same time, and at each detent position, the motor brake winding is shorted by one of the switch sections. If the "open seeking" switch section finds an open, the slowed down motor stops quickly without moving the rf section past the detent. If the open is not found, the motor speeds up and goes through the cycle until the open is found.

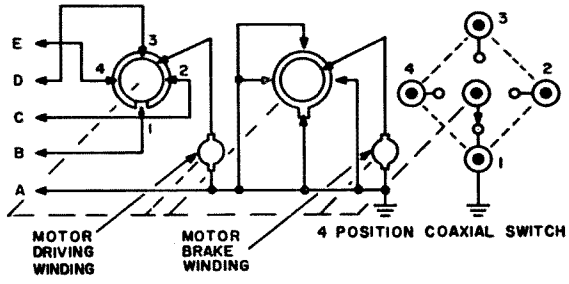


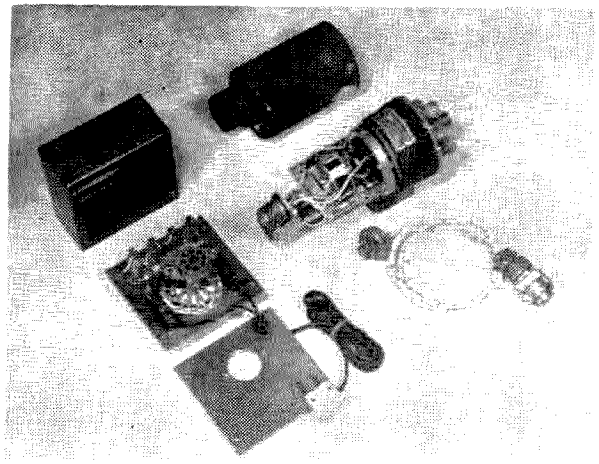
FIG. 1

The specifications in Table I for the rf switch cover only VHF and microwave applications but the switch may be used from dc to the maximum rated frequency.

The PM drive motor will operate from a dc source of between 20 and 30 volts. The simple approach for amateur application is to install a dropping resistor and silicon rectifier in series with the ac power line and operate the motor with the pulsating dc current. This system was tested and found to work very well. There is, however, one precaution that must be observed if this method is used. In the SA-325/U, Pin "A" of the connector is grounded, along with the motor brushes and the brake winding switch contacts. THESE GROUNDS MUST BE LIFTED, REPLACED WITH INSULATED LEADS, AND THE ENTIRE CIRCUIT INSULATED TO WITHSTAND THE FULL AC LINE VOLTAGE.

Table I

Frequency Range	30-11,000 mc
VSWR	1.1:1 Maximum between 100- 1,500 mc
	1.2:1 Maximum between 1,500- 4,000 mc
	1.3:1 Maximum between 4,000-11,000 mc
Insertion Loss	0.5 DB average at 7,000 mc
Attenuation Between Connectors	60 DB average at 7,000 mc
Characteristic Impedance	51.5 Ohms
Power Rating	100 Watts CW at 3,000 mc
Voltage Rating	1,000 Volts RMS



An exploded view of the surplus SA-325/U coaxial switch and the home built control unit with power supply.

This poses no problems except in the case of the grounded motor brush holder. A lead is soldered to the brush support bar and the area where this bar passes through the insulator plate built up with epoxy cement. After the cement is thoroughly dry, the bar is cut at the point where it is staked into the motor casting and the ends dressed to provide adequate clearance. A strong, well insulated assembly results and no difficulty has been experienced.

The control unit, shown in Fig. 2, is quite simple. While it is unconventional to fuse both sides of the ac line, it was considered desirable in this case. The 20 ohm dropping resistor supplies between 20 and 30 volts, measured with a dc meter, to the silicon diode and the motor winding. Although the 25 watt resistor is greatly overloaded in this application, the switch cycles through all 4 positions in less than 5 seconds. Because of the short duty cycle, no undue heating occurs.

The same considerations apply to the silicon diode. A .75 ampere, 400 PIV unit is used and no problems have been encountered. Once again, the switching cycle is completed before excessive heating occurs. If this gross overloading is considered objectionable, stud

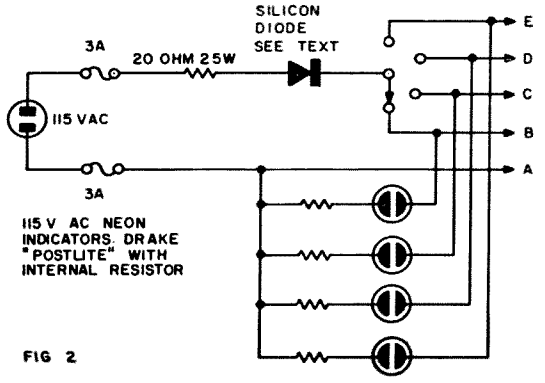


FIG 2

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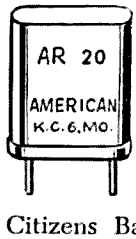
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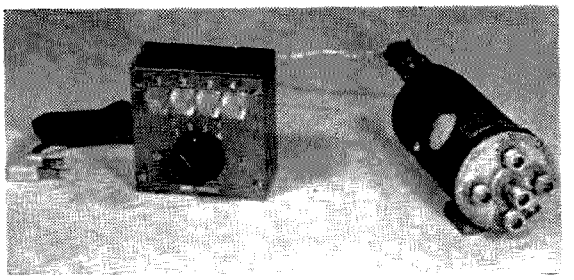
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The completed project is shown in this view. The modified surplus switch and the control unit operate from the ac line.

mounted units are now quite reasonably priced. TAB of New York (index) lists 2 ampere, 200 PIV units at 55c, 300 PIV units at 80c and 400 PIV units at $1.00.

The complete control unit and power supply is housed in a 2″ x 4″ x 4″ utility box and it all fits nicely. The photographs show the construction details and the completed system. The selector switch connects power to one of the 4 contacts in the SA-325/U. The pilot lamps are connected to each of the contacts and returned to the negative power lead. The lamps are extinguished until the motor circuit is opened. At this time, 115 volts pulsating dc is applied to the appropriate lamp. This feature is quite convenient since the lamps light only after the remotely located switch has completed its cycle.

An octal socket is mounted on the rear of the box and is used to connect the 5 conductor cable to the SA-325/U. The connector on the SA-325/U is a common AN or MS type. The mating cable connector is an MS3106A14S-5S. An AN3057-6A cable clamp with bushing completes the connector. You can probably save money by visiting your surplus dealer for the connector.

If manual operation of the rf switch is desired, remove the motor shell and remove the 4 screws which hold the motor drive to the switch. The switch may be chassis mounted on the original mounting feet. A splined shaft extends from the switch and a standard ¼″ flexible coupling may be attached to the shaft. Add an extension shaft through a bushing in the equipment panel, add a knob and you are in business. Restrain your curiosity and do not open the rf switch unit proper. A very strong spring is used which may flip out. Assembly is very difficult.

All in all, these remotely operated coaxial switches are valuable additions to any ham shack. When modified and installed as described, they provide a low cost answer to many antenna switching problems. The switch and control unit can easily pay for themselves in coaxial cable saved. . . . W4WKM

The National NC-303 is not for every amateur...

Frankly, the NC-303 Is an expensive receiver. And not every ham is willing to spend $449 to enjoy the maximum in receiving convenience and performance. The NC-303 is not a "compact" light weight. It's packed with 78 pounds of husky components to provide a little bit better reliability and performance than the next receiver. The NC-303 offers certain advantages. Sensitivity, for example, is an honest 1.0 microvolt or better for 10 db AM signal-to-noise ratio (this is not a misleading CW measurement or one based on a 6 db S/N), and the NC-303 is quiet — no operator fatigue from background noise bursts.

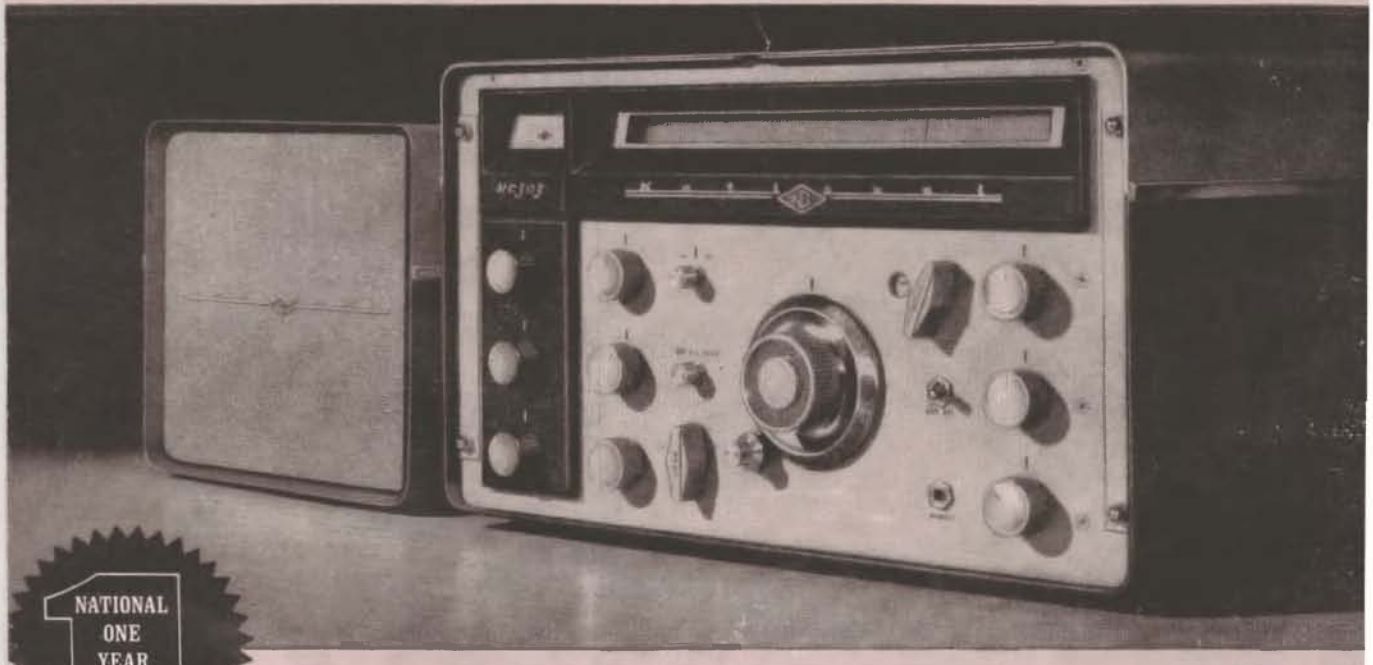
Selectivity is remarkable (six tuned circuits at 80 KC result in extremely steep skirts on SSB and CW) . . . and the '303 offers the widest selectivity range available on any hamband receiver — 400 cycles through 8 KC. Stability, both mechanical and electrical, is quite out of the ordinary. No need to tip-toe around the shack. In fact, tune a CW signal and employ the classic "drop test" to see for yourself. Incidentally, we consider 100 cycle thermal drift after a short warm-up to be unusual.

"This is all very well", you may say, "but not a great deal better than competitive receivers". We agree — for four hundred and fifty dollars you should expect much more than this, and so we give more to you. The most expensive dial drive in the industry to provide smoother inertia tuning than any receiver on the market, regardless of price. The NC-303's band switch mechanism even employs a Geneva movement . . . you just start it on its way . . . it does the rest of the job by itself. No wiggling back and forth to make sure every contact is engaged. This switch snaps in with a satisfying clunk and stays there. (Try tuning a signal on one band, then flip to another band and back again.)

Other extras include complete coverage from 160 (by the way, the '303 is the only SSB hamband receiver now on the market which incorporates 160) through 1¼ meters with separate 12" slide rule drum dials for each band, and accessory converters are available for the three VHF bands. Even a separate converter input is provided. Dial calibration is to 1 KC on the lowest band, to 2 KC through 15 meters.

The '303 also offers the best SSB AVC you've ever heard. No pops, thumps or distortion . . . just a constant gain level through local or DX QSO. There's an audio response control for CW peaking or VHF scatter work . . . an active nulling Q multiplier for 50-60 db notches, complete with depth control . . . an unusual noise limiter which cuts impulse noise without signal distortion, plus adjustable CW/SSB limiting. Even external provision for RF gain control for CW break-in operation and an accessory socket for receiver accessories or adapters are included.

The NC-303 was not designed to meet competitive price or performance, but to provide maximum hamband performance for every type of operation. Not just SSB, not just AM, not just CW . . . but every mode. As a result, it costs more than the average ham receiver. On the other hand, if your requirements are for more than "the average", perhaps the '303 should be your next receiver. Why not operate one soon and find out?



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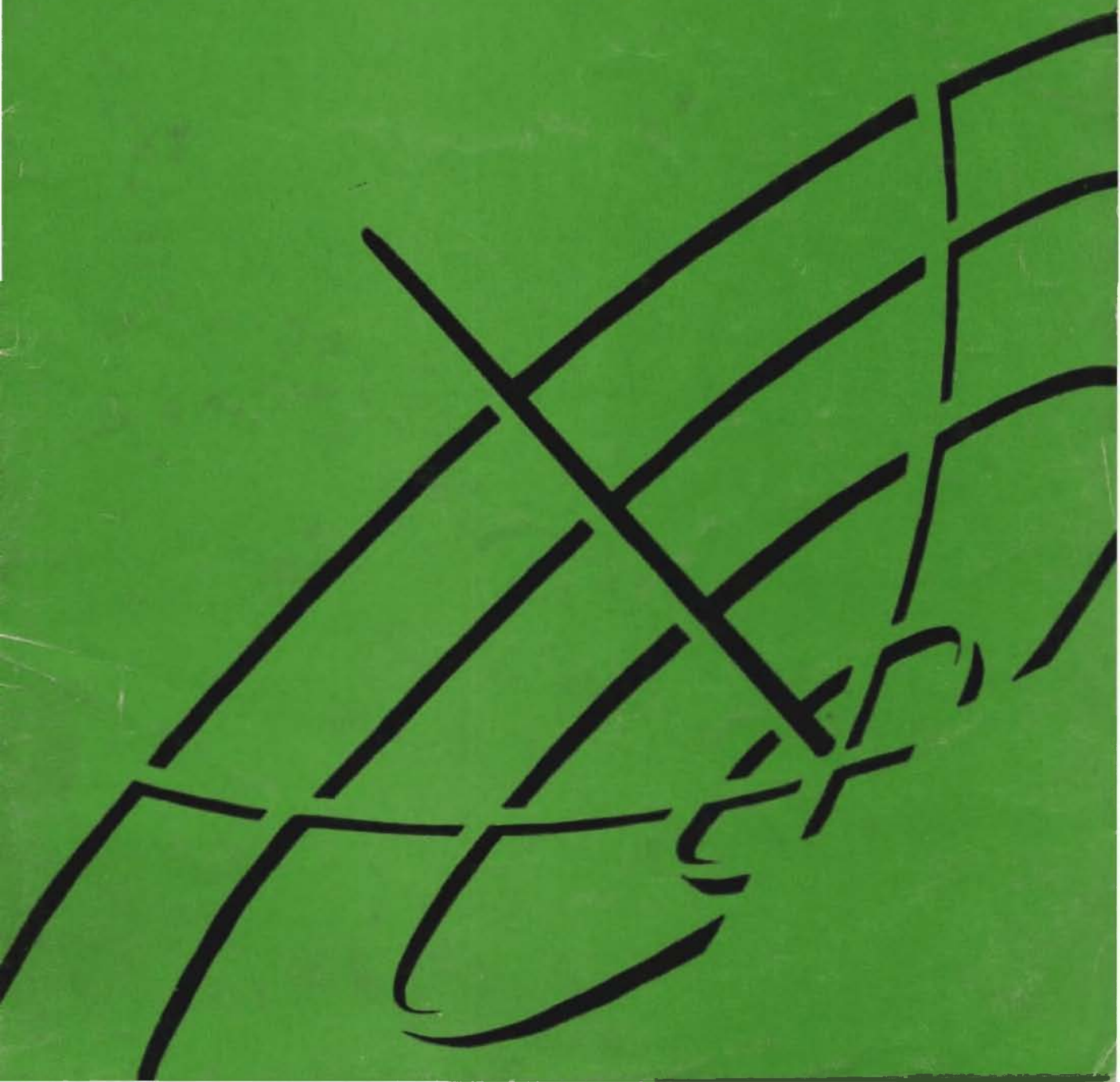
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Cover: W1MEL.

W2NSD/1

Never Say Die

SEVERAL vacationers have stopped by for a hello and been put to work hanging up antennas and sorting out radio equipment from the hundreds of cartons all over the barn. Paul Day W1PYM has practically become a staff member by now, having spent almost his entire vacation here. Now he usually turns up around dinner time and puts in a strenuous evening working on some project or other. Dave Brown K2IGY came up in his Porsche for a short visit and found out how much trouble we have to go through each month to prepare his propagation chart for publication. We sat him down at a card table (our version of a desk) with a large blank chart and hundreds of strips of patterned paper to paste on the chart. Two days later he got through and headed back to Long Island vowing he would never come back here during chart makeup time.

Another welcome visitor was Paul Smith WA2SPB who spent three days with us carrying around all the heavy things we could find for him plus installing an intercom and about two hundred other odd jobs. He swears he had fun. Jesse Adams K1LYC, a naval surgeon from Kittery, Maine, stopped by and was soon put to work assembling steel shelving to hold the ham gear. Unless we get a lot more filled up with permanent guests than we are now we can put up any visiting firemen for the night, and may well have some little chore to keep them out of mischief. Porsche pushers particularly welcome.

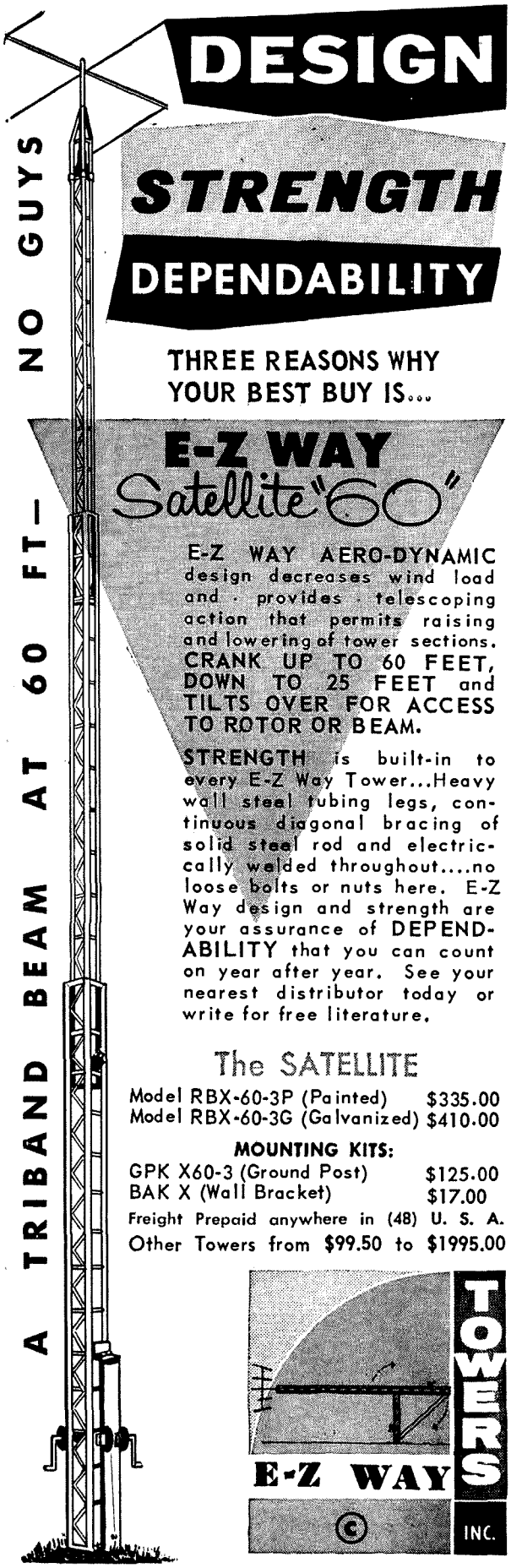
A Ball

The new headquarters building is teeming with activity. Towers are going up. Beams are being swung. Rigs are being assembled and hooked up. The request for help brought several good answers and we have a happy little staff living and working together to put out 73 and get as much ham gear on the air as possible.

After just three weeks we are set up with something on all bands from two through 80 meters. We'll get on the rest of them before long too. Next we will start putting in amplifiers and bigger antennas so we can really be heard. I don't know how many of you appreciate what an exciting thing it is to be able to get on the air again after being buried in the middle of Brooklyn for some years. Now, when I call a KX6, he comes back to me. Even on six meters I can sit there and work one DX station after another. There was a little matter of my TVI wiping out channel two for the entire town, but then Peterborough isn't very large. I whipped out the Gavin filter which I had somehow neglected to return after our little test of it this month and brought the TVI under control.

We can still probably use one or two more eager beavers who are interested in hamming more than money. We have a lot of ham gear to install, a lot of booklets to put out, and a lot of work to be done for 73. In return for this we will provide room, board, and some pocket money and a wealth of fun and experience. Absolutely no smoking or drinking here though.

This issue of 73 rounds out two years of publishing. The magazine is going well . . . almost everyone likes it and we have enjoyed a growth rate that is a phenomenon in our field. We have our new gigantic quarters with a fine ham station being installed and an impressive test lab being built in. We have the first of a growing group of regular employees. Our Math, Coils, Mickey Miker, Ham TV and



Surplus Index books are in print and we have a whole raft more in preparation. Things look pretty good.

We are going to do everything we can this fall to make sure that as many amateurs as possible are convinced to subscribe. Those of you that like what we are doing and want to help can accomplish a lot by mentioning our articles and the magazine during your QSO's. You can talk up 73 in club bulletins and at club meetings. We try to be restrained in our promotion, leaving the enthusiasm up to you.

In the closing part of my editorial last month I hinted that readers might pay a bit more attention to the companies that are advertising in 73. Ron Levine of Polytronics was afraid that this might lead to problems for every-other-month advertisers, who might be considered non-advertisers half of the time. This is a complication, to be sure, but I doubt if anyone will forget the four page Polytronics ad in the April issue. Another reader suggests that we give the name of the advertising manager in a list in 73 so the readers can write to the right man and register their opinions. This might lead to some emotional problems. When in doubt address your letter to the president of the company and let him pass it to the advertising manager.

Club Subscriptions

There is still time to get in your club subscriptions at our present low rate if you get a move on. Used to be we could only handle new subscriptions at this rate, but we've enlarged our staff and can now handle renewals as well. The special club rate is available to any group, whether spontaneous or organized, that submits five or more subscriptions at a time. This saves us enough time so we can afford to present you with a bit of rebate in the form of a lower rate. Use a separate sheet of paper and send us your list. Be sure to mention the name of the club somewhere as well as the names, QTH's and calls of subscribers. We also like to know whether it is a new or renewal subscription. All club subscriptions will start with the next published issue unless rather obvious attention is called that you desire otherwise.

Club rate: $3.00 per year, five or more at a time.

VHF Amateur Defuncts

Though the details are somewhat obscure as yet, it does seem as if CQ has gobbled up

(Turn to page 58)

Synchronous Detection

How to read signals that are 40 db under the noise

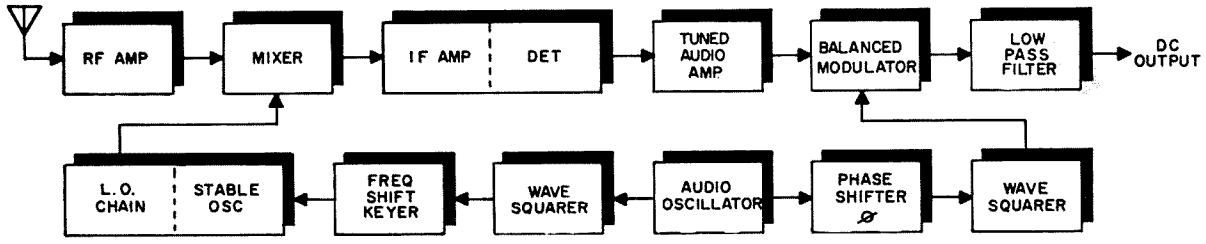
Bill Ashby K2TKN
Box 97
Pluckemin, New Jersey

LITERALLY thousands of engineers and entire engineering divisions of many large companies as well as countless other people have spent millions of hours attempting to improve the ability of a receiver to extract a signal from a noisy spectrum. To improve signal to noise ratio has been a prime objective for many years and because of the very evident thermal noise in the first stage, most work has been in this area. The present state of the art and available components results in less than a 4db signal plus noise to noise ratio—using tubes below 400 mc and diodes above. There are two known methods to improve on this, the MASER amplifier, and PARAMETRICS. The MASER will get down to less than 1db, but is very complex (expensive) and therefore feasible only to the military, universities, Bell Telephone, etc. A PARAMP is not hard to build, once you know how, and SAM HARRIS, WIBU/WIFZJ single-handedly gave this knowledge to the world, but neither device will improve things much more than 10db actually overall in signal to noise.

Starting with Grote Reber many years ago, a W9 at the time, a completely different receiving problem has been the object of much research. This is Radio Astronomy, where the information desired is Noise, which is buried in noise. They use the finest front ends but have developed many methods of detection not previously applied in the communication field. These systems are based on schemes to force any locally generated (within 100,000 miles) noise to cancel out, leaving the desired information available for use. The Lamb noise silencer, Collins noise blanker system, Frequency Shift RTTY are some very simple versions of this that will improve Signal to Noise many db under certain conditions, but have very little effect on thermal 1st stage noise—the real problem.

Space communication and telemetery research has come up with several systems to improve signal to noise ratios but the majority are lock-on systems that require bursts of good signal to reference against or prediction of where and what kind of signal is going to be received as well as when. These have had very little success in Amateur applications to date.

Out of all of this it would seem that it is possible to combine advantages of each area of research and to build a receiver that is a radical improvement over what was known 25 years ago. As Sam Harris says, "Amateurs have never actually worked weak signals," and he is right. In his own case, the finest receiving technique and equipment ever assembled for amateur use, and probably any other, is being used at W1BU for moon work on 1296 mcs, yet he listens to over one volt of raw noise plus signals that seldom exceed .05 volts. He



admits it took almost a month to learn what to listen for. I said, "Why not get rid of some of that noise," and his answer was "What noise?"

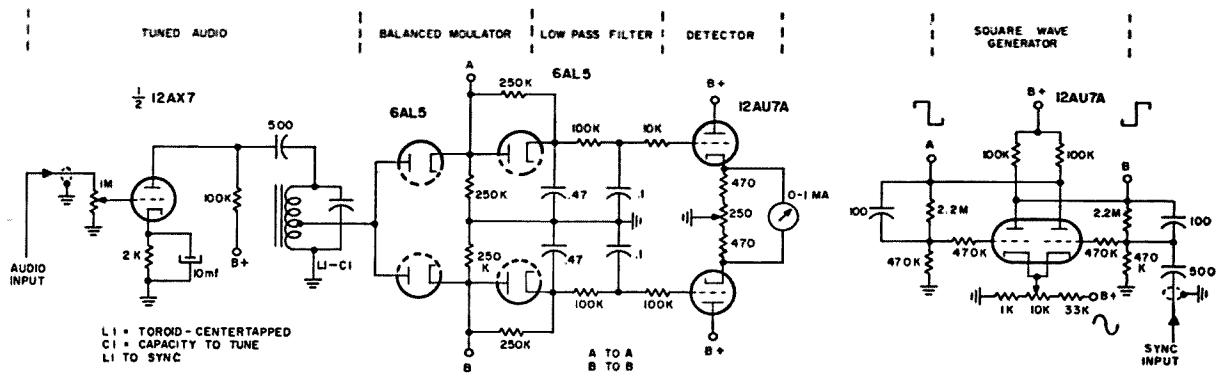
He has developed the first molecular anti-noise detector right between his ears and beard! This reminds me of a few years ago, with one of my first really sharp receivers—W9ECZ listened for a while to this six foot rack of *if's*, etc., with about 100 cycles of total band width, to the pile-ups on the low end of 20 and then said "Very nice, but how do you keep track of what's doing on the rest of the low end?" My tin ear on CW requires listening to one signal at a time, and I have found that my head does not cancel noise, it generates faint "CQ de W1BU" in several watts of noise after a few minutes.

All of this has led to no sleep in the past few weeks and definite information on a lot of circuits that will not help, but one combination of systems has excellent promise of fantastic results.

The Sync detection system borrows from many sources a number of techniques.

(a) A stable frequency is locally generated. This can be from a few cps to ultra-sonic, depending on the application. For purposes of illustration—say 400 cycles.

(b) A square wave derived from this 400 cycles is used to F.S.K. (Frequency Shift Key) the local oscillator chain so that the front end of the receiver is alternately looking at two closely spaced frequencies, possibly 100 kc apart on 1296 mcs, one of which is tuned to the desired signal. Information is being fed the *if* Strip, detector, and audio that consists of galatic and front end noise that is the same on both channels, and any signal, noise, etc., that appears in only one channel – that will appear to be signal with heavy 400 cycle modulation. Band width of these portions of the receiver are not important as long as the two channels are selectively scanned.



This does not require switching of the antenna input, which is inherent in most Astronomy setups, and does not require components that can't even be swiped, let alone purchased by normal human types. A number of systems have been tried that were of the frequency diversity type, based on two channels of reception, each on a different frequency, whose outputs were tied together so that noise cancels but a signal in one channel gets thru. Noise is not coherent so 6 or 8 db actual was about all that could be gained in practice. Band width of detection is a very serious matter. Theory based on Boltzman's Constant says that if the band width can be made narrow enough, any signal to noise ratio is possible. In practice about 100 cycles is the narrowest band width that can be handled, due to tuning difficulty and limitations of the human hearing mechanism. Narrowing up, and using a pen recorder can improve things many db, but if you can't keep the receiver tuned to the signal, it is of little practical value.

(c) The audio output from the normal detector, consisting of a lot of receiver noise, a little cosmic static, and maybe .001 percent modulated signal is put thru a very selective 400 cycle filter. This removes everything but 400 cycle noise and 400 cycle modulation of the signal, and these are fed to the balanced modulator.

(d) The same 400 cycle frequency generated in "a" is fed to a phase shifter then is squared off and this is fed to the balanced modulator.

(e) The balanced modulator not only is selective as to frequency but selects phase as well. Signal that is modulated with 400 cycles is compared with the original 400 cycles in the balanced modulator. Output is only upper and lower side band products of the two. We are interested in the lower only so a low pass filter is used to eliminate the upper sideband at the balanced modulator output.

Since the two signals being compared are of the same frequency, the lower sideband is

zero. *This is dc.* If the two frequencies are in phase, the output is dc of one polarity and the amplitude is proportional to signal strength. If the phase is 180° the output is dc of the opposite polarity and proportional. This means signal in one receiving channel gives positive output and one gives negative. There is 30 to 40 db of suppression of any information that appears on both frequencies. Since any signal within the pass band of the entire receiver is converted to a 400 cycle component, this system will not work under QRM, but there isn't any yet above 400 mc. There is no tuning problem—overall band widths of 10 cycles are easily obtained. The dc output of the balanced modulator is used to key an oscillator for CW, drive a pen recorder for real weak ones, or modulate an audio system but here the 400 cycle master oscillator would be raised to 10 kc.

Preliminary work has shown that a minimum of 30 db signal to noise ratio improvement can be obtained on slow speed CW!

This article is a plea to try to cut down the development time cycle by Amateurs. This sync detector along with State-of-the-Art receivers and a Preamp will allow 432 and 1296 moon work with yagi antennas or square corners and 2C39's. If W2AZL, W6NLZ, WIFFR, WIRFU, K2LMG, W4HHK, W6AJR, W6MMU, W2TTM, just to name a few, start on some version of this scheme, we will beat the commercials a mile as usual. As working circuits finish tests, full info will be appearing in 73. These tests are aimed at good reception of W1BU and KH6UK with a six foot dish and a lot of feed line. More later! . . . K2TKN

Reference: "Lock-in Amplifiers" Electronics; June 8, 1962: Robert D. Moore.

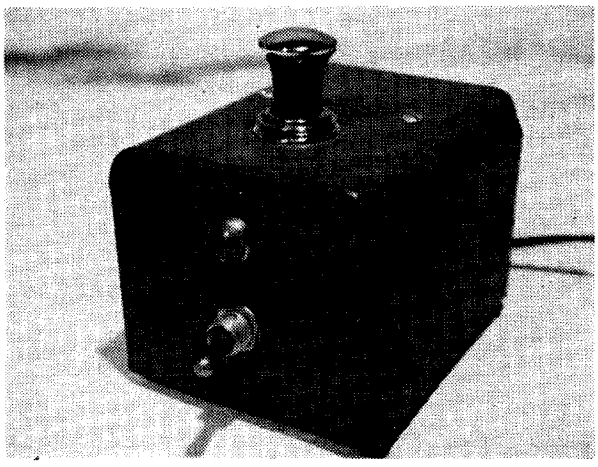
An Electric Cigarette Lighter

for your shack

Charles E. Spitz W4API

Since I have spent a good deal of my life working on developing lung cancer by smoking, and because there are few better times to pursue this hobby than when relaxing by the rig talking to a buddy, I have always found it annoying when my cigarette lighter runs out of fluid just as sked time approaches. And so I decided to rig up a lighter that would always be ready for use; an electric one.

Although a resistance wire across the ac line would give a suitable hot plate, this idea was discarded because I prefer to be isolated from the line. Between the junk box and the nearest auto supply store I was able to find parts to put together a transformer isolated system using a pop-up cigarette lighter, as may be seen in the photograph.



An ordinary filament transformer is bolted inside of a small metal cabinet and is connected to an automatic lighter well. The MO is the same as in your car; press the lighter knob down and the lighter springs up when hot. Through trial and error I found that the lighter works best with 7.5 volts ac. If you do not have a 7.5 volt filament transformer, you can use a multiple filament transformer, placing the 5 and 2.5 volt windings in series. If you don't have these either, you can get by with 6.3 and 2.5 volt windings in series, taking care to phase the windings so that the voltages add. If one is reversed you won't do any harm, but the lighter won't work.

A pilot light was installed to show when the lighter is on, however so little current is drawn when the lighter is not pressed in that this frill may be discarded and the unit left on all the time.

Since it takes a fair amount of pressure to push the lighter down, and the heating unit cools rapidly, this gadget should be safe even if small children wander into the shack. And perhaps it will be such a success that the xyl will ask you to make more for the rest of the house. . . . W4API



73 Tests The Maverick Tunable Six Meter Filter

Larry Levy WA2INM
1114 East 18th Street
Brooklyn 30, New York

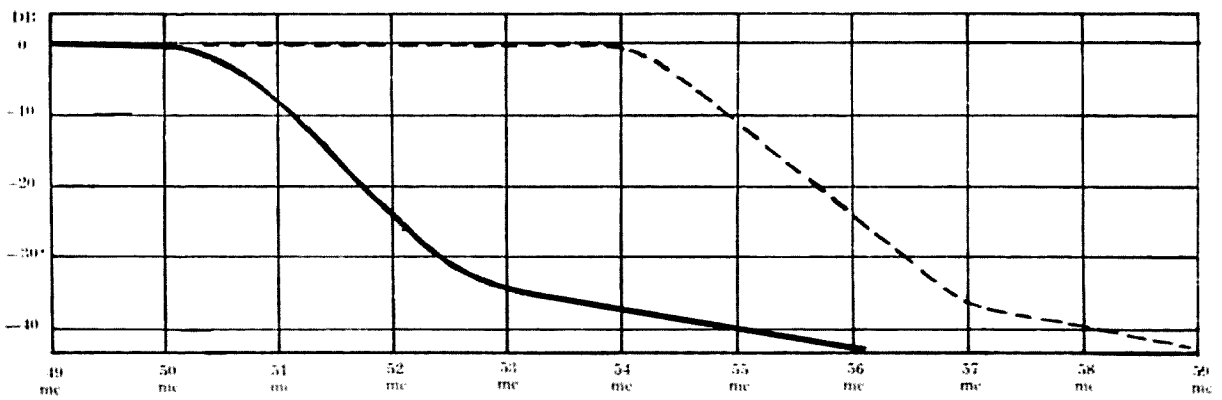
THE Maverick Six Meter Filter is one of the few low-pass filters that have been designed with the special problems of six meter operation in mind. There are five stages of the constant K and M derived types, all tunable. The combination of K and M filters provides the sharpest cutoff with the lowest insertion loss. This is tunable and the advantages over fixed tuned filters of a similar design are many. One is that fixed tuned filters are usually set for a cutoff frequency of 52 mc and will start to effect the SWR as low as 51½ mc. With the increased activity on the band, as well as the growing use of wide-band FM, such a filter presents problems. The Maverick can be adjusted for a cutoff of up to 54 mc so that you can operate as high on the band as you want and still be able to suppress TVI. There are several other uses for the Maverick. It will prevent converter front ends from being overloaded by strong TV stations it will suppress unwanted and spurious mixer products in SSB rigs and it will even match a 52 ohm line to a 72 ohm line.

Tests on the filter have shown that the suppression of unwanted signals to be at least 35 db, with less than one db of insertion loss. The tuning is extremely simple. Connect the filter between the antenna and the transmitter and peak all of the five stages for maximum output, as measured on an SWR bridge or other output indicator. The filter comes from the factory with a cutoff of 51 mc. I made a few tests on a little transmitter which seems to be designed to give a large amount of TVI. Without the filter, it takes out several channels of a nearby television set. With the filter in the line, there is no trace of interference on any television channel. This seems to prove the effectiveness of the filter quite conclusively, as all kinds of test-bench measurements are completely useless if the filter will not eliminate TVI when connected to a transmitter. The filter will handle up to 400 watts at the antenna. It is manufactured by Gavin Instruments and sells for $16.95. The attenuation curves are shown in Fig. 1.

. . . WA2INM

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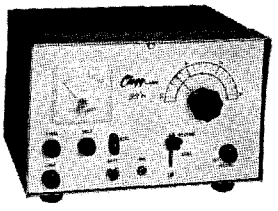
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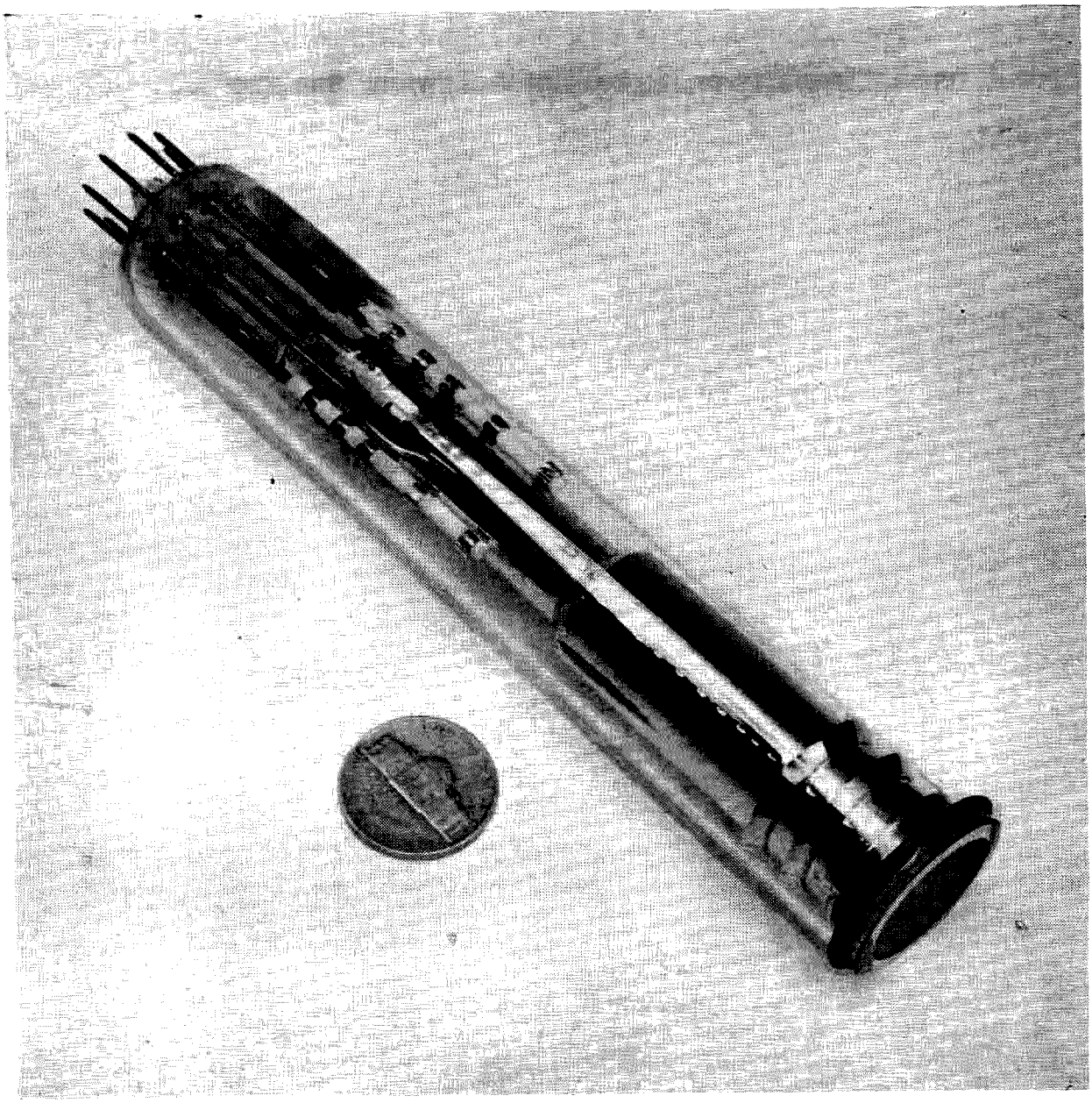
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What's a Vidicon?

Fred Haines W2RWJ
123 Roberta Drive
Liverpool, New York

IF you aren't on speaking terms with the vidicon television camera pick-up tube, then you should definitely read on. You see, the vidicon tube is a most remarkable electronic device which in about ten years has virtually made the phenomenal growth of closed circuit television possible. The image orthicon, used extensively in broadcast TV, is a more sensitive and refined tube, but its cost and the complexity of its associated circuits have ruled it out for use in inexpensive television systems. Of course this applies also to ham television, and the vidicon will no doubt become known as the single advancement which contributed most to the popularization of Amateur TV.

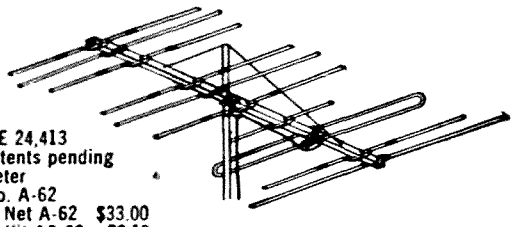
In this discussion we shall describe the vidicon tube both physically and electrically, with emphasis on the internal process which results in the formation of a television signal.

The first and most basic requirement in any television system is the conversion of an illuminated subject or scene into an electrical equivalent. This may be thought of as analogous to the action of a microphone which converts sound waves into an electrical equivalent called an AUDIO signal. The vidicon tube with its associated circuits produces a VIDEO signal which is the equivalent of the scene to be televised.

Refer to Fig. 1. which illustrates the internal construction of a typical vidicon tube. Note that it consists basically of an evacuated tube with an electron gun at one end and a semi-transparent photiconductive layer at the other. The bulb is just over 6 inches long and is about 1 inch in diameter. Just for the record it's interesting to note that experimental vidicons are in use which are ½ inch and 1½ inches in diameter. These at present are for special purposes and are not in common use. A new family of short vidicons only 5 inches long is just becoming popular, but they are identical electrically with the older and standard 6 inch tube, except for slightly less heater current drain.

You've probably noticed already that the vidicon bears a family resemblance to the picture tube in your TV set, an electron gun, some grids, and an anode. So far, so good, we're on the right track. Instead of a phosphor screen to light up when struck by the electron beam however, a new element called a signal electrode or target is found. The target has the interesting property called photoconductivity. That is, it is made from a material which is an insulator in the dark and a conductor in the light, the degree of conductivity depending

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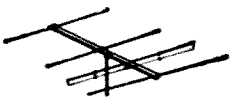
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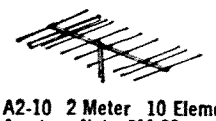
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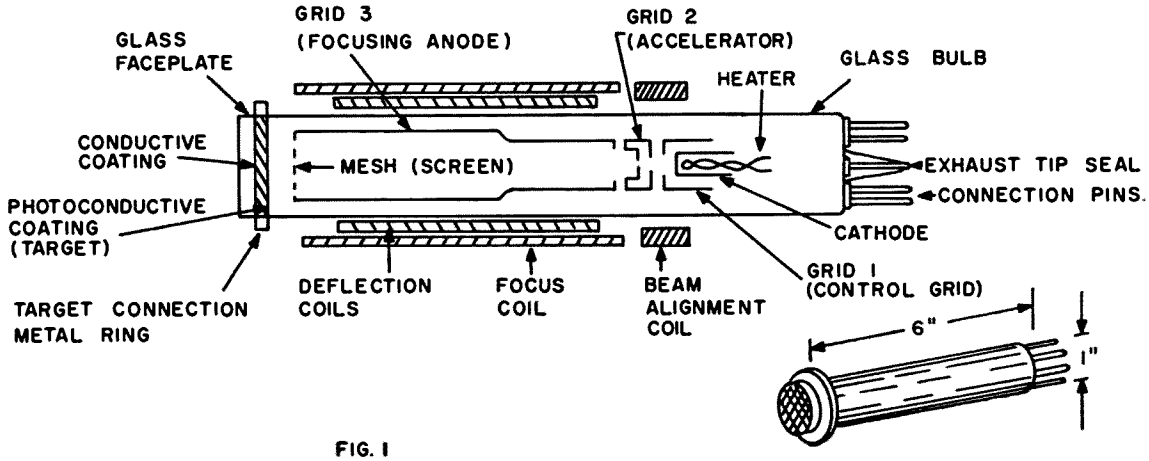


FIG. 1

upon the intensity of the light! Aha, you say, a photocell; and you aren't too far wrong, because the target can be considered a photocell having special properties.

Now, before we can proceed with the internal action of the vidicon, we must review the basic idea of scanning. Scanning, as you know, is the process resorted to in order to break a scene down into small parts or areas. This is required because a television system cannot transmit conveniently all of the information in a scene simultaneously. Therefore the scene is broken down into strips by a scanning pattern. When the electron beam in the picture tube of a TV set "paints" the picture on the phosphor screen, it is duplicating the scanning pattern of an electron beam in the television camera pick-up tube.

Any number of scanning patterns can be devised, but the standard one in the United States will be described. Refer to Fig. 2 which shows a basic scanning pattern. Note that the electron beam starts at the top left and proceeds down the pattern by moving back and forth horizontally. The beam is steadily moved downward as it scans from left to right so that it eventually reaches the bottom of the pattern, is moved rapidly to the top left, and repeats the scanning pattern over and over. Each horizontal scan from left to right is called a televsion line. The entire pattern taken once is called a television field.

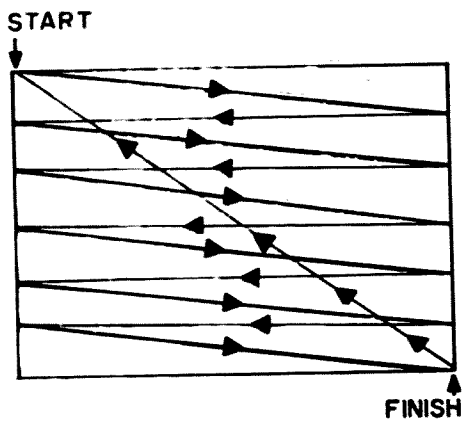


FIG 2

Fig. 3 depicts the television pattern in actual use in the U. S. It is similar to the basic scan in Fig. 2, but it is made up of two fields which are interlaced. The two interlaced fields together, taken once, are called a television frame.

This really isn't the place to expound at length on television scanning patterns and philosophy, but we can't leave anyone up in the air wondering why all the trouble of generating an interlaced scanning pattern is considered worthwhile. One reason which is sufficient in itself to make interlace valuable is the degree it tends to minimize the effects of static and other interference when the television signal is transmitted over a radio link. Assume that a burst of ignition noise occurs during the first field of a frame but not during the second field. Since the first and second fields essentially contain the same picture information, only half as much bad effect (picture tearing) is noticed. Another, and perhaps more basic for interlace is that less flicker is apparent in any picture as the frames per second are increased. Interlace gives the effect of increasing the frame rate without actually doing so.

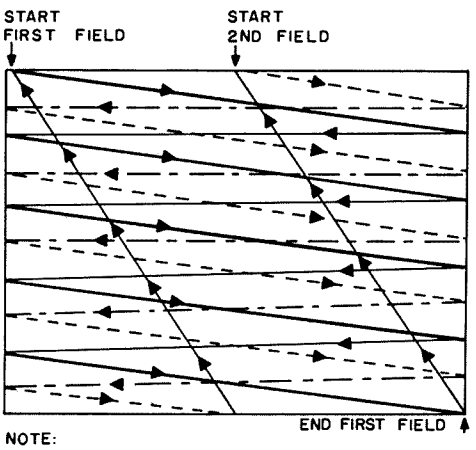
Now back to the vidicon for a spell (Fig. 1). The cathode-heater assembly produces electrons which are attracted by the electrostatic field created by the high potential applied to the second grid, the accelerator grid. Grids 1 and 2 are equipped with holes through which the electrons must pass, thus resulting in a fine round beam of electrons squirting out of grid 2 into the grid 3 region. At this point electron optics comes into play, and the beam is focused into a fine point at pre-

cisely the spot where it strikes the rear of the target surface. The focusing action is the result of an electromagnetic field produced by the focus coil outside the tube, and the electrostatic field of grid 3 which is connected to a relatively high voltage. To achieve exact beam focus, the voltage of grid 3 is varied. The voltage applied to grid 1 determines the strength of the electron beam hitting the rear of the target surface.

Now consider the deflection coils which are wrapped around the outside of the tube. Currents are caused to flow in the coils which then, through magnetic action, deflect the vidicon electron beam in the scanning pattern we previously discussed. So it is then, that the scanning beam strikes the rear surface of the target photoconductive layer.

A detailed representation of the target area of the vidicon is illustrated in Fig. 4. It's interesting to note that the glass faceplate of the tube is ground and polished optically flat so no distortion of the lens image will occur. The rear surface of the faceplate is coated with a transparent but electrically conductive coating. Over this is deposited the layer of photoconductive material, which the electron beam is scanning.

In operation, the front surface of the photoconductor is held at a positive potential with respect to the tube cathode of some 30 volts, give or take. This is applied to the tube through the target contact metal ring which connects internally to the transparent conductive coating.



NOTE:
ONLY TEN LINES ARE SHOWN HERE,
525 LINES IS THE U.S. STANDARD.

FIG. 3

The scanning electron beam deposits a charge pattern of negative electrons on the back surface of the target. Where the photoconductor is dark and its resistance therefore high, the negative charge accumulates until it reaches the same potential as the cathode;

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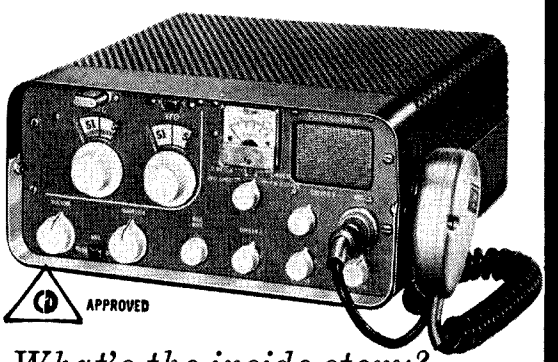
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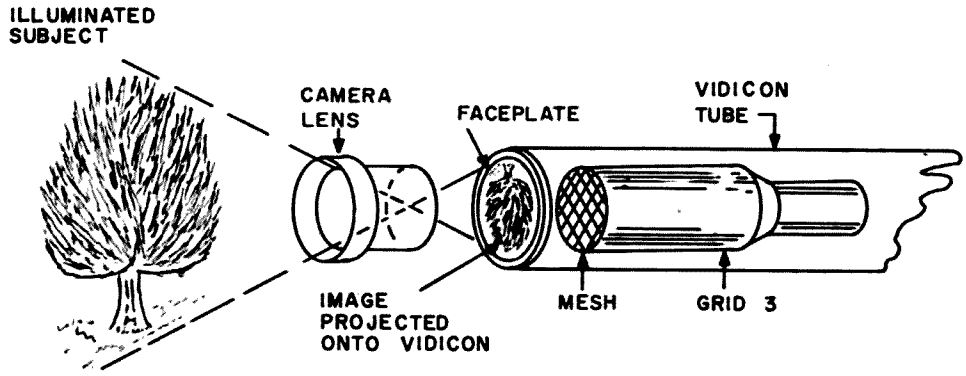


FIG. 4

any further electrons will be turned away.

Where light falls upon the photoconductor however, the conductivity of the material is substantially increased. The electron charge here leaks through the photoconductor to the conductive coating of the faceplate and flows in the load resistor, R_L (see Fig. 5). The resulting voltage across the load resistor is the video signal which is then suitably amplified and transmitted through coaxial cables or over the air to receivers or monitors.

Let's tie up a few more details which would have cluttered up the preceeding explanation. First, notice the fine screen mesh at the end of grid 3 nearest the target. The scanning electrons must pass through the mesh to reach the photoconductive layer. The purpose of this screen is to provide a uniform decelerating field in the vicinity of the photoconductive surface. What this means is, we want the electron beam to slow down just before striking the target so it won't "splash" all over and spoil the focus of the scanned pattern. The screen has holes, so the beam moves through and doesn't realize until it's too late that the screen is actually at a higher voltage than the target. At that point the beam wants to slow down and turn around to go back to the screen, but it strikes the target first at the lower velocity desired.

If you've been wondering about the extra coils around the vidicon in Fig. 1 called alignment coils, your curiosity is about to be satisfied. Due to the extremely close tolerance required when putting such a complicated tube together, and considering the small diameter of the holes in the grids 1 and 2 through which the beam must pass, it's no wonder that the holes are not always perfectly aligned on the same axis. The alignment coils then are placed over the vidicon and create two magnetic fields which are perpendicular to the axis of the tube and to each other. When the strengths of the fields are adjusted, the beam can be deflected up, down or to either side, allowing it to pass properly through the two holes in grids 1 and 2.

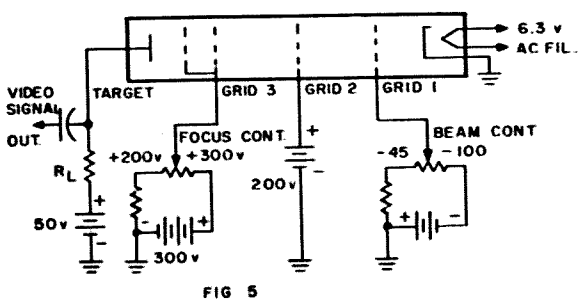


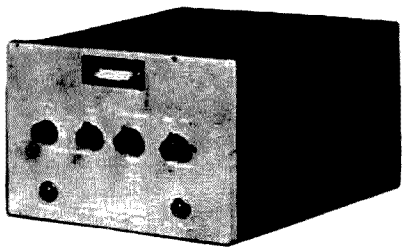
FIG 5

The vidicon has another advantage in terms of low cost operation. It is designed to operate with 16 mm movie camera lenses, which are small and relatively inexpensive, beside being commonly available. To be exact, some 16 mm movie lenses will not work perfectly with vidicons, and before a lens is purchased it is well to check with the lens manufacturer as to whether a particular lens is "vidicon format" or not.

At this point we have introduced ourselves to the vidicon camera pick-up tube. We have a fair idea of the internal action which produces a video signal. However the surface has barely been scratched in terms of the electronic circuits required to come up with a complete television system.

Some vidicon manufacturers market a grade B vidicon at a large price reduction, the reason being some relatively minor flaws in the photoconductive surface which show up as small spots in the picture. Another manufacturer who specializes in deflection, focus and alignment coils is offering these in relatively low cost sets. The time is here for some of us who are truly interested to do some investigation in this area. If you are interested in some further info, let Wayne know about it and we'll see what we can work up. . . . W2RWJ

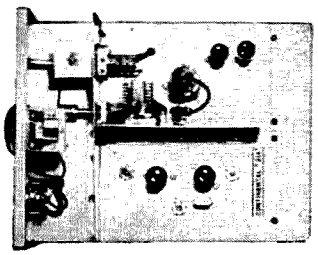
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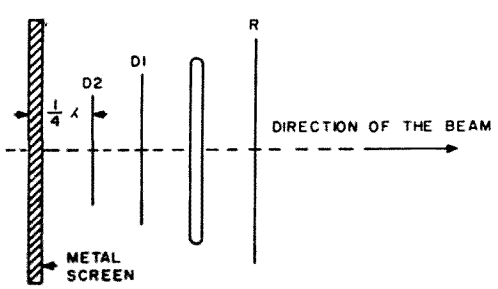
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Reverse Beam Antenna

Several European radio magazines recently described a so called "Reversed Beam Antenna" for VHF bands. Additional 5 db is claimed due to the narrowing of the beam (approximately twice) compared to a regular Dipole-Director-Reflector arrangement.

This is accomplished by pointing a regular Yagi toward a large 2 x 2 wavelength reflecting surface and *AWAY* from the station you are in contact with. Reflecting surface (it can be a solid metal or a screen) is located ¼ wave from the nearest director.

Same idea can be used with the stacked beams and a correspondingly larger screens. Antenna was used successfully on 144 mc and on all television channels. There is no information on how this screen affects the input impedance. . . . K6BIJ



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FOR operation of transmitting and receiving equipment there is often a requirement for additional filtering between the equipment and the antenna. In a typical hf installation, this usually is accomplished by low pass filters and/or antenna tuners consisting of conventional lumped L-C circuits. At frequencies of 144 mc and higher low pass filters are not easily realizable because of the poor performance of lumped circuits. There is also an increased need for attenuation of spurious responses—it's less than pleasant to have television, taxicabs, airplanes, etc. superimposed on a 144 mc signal. The long multiplier chain of the typical VHF transmitter with its inherent potentialities for unwanted harmonic radiation argues for a highly selective filter in the output when transmitting.

The case for this hardly needs lengthy arguments and the obvious solution is a high Q resonant circuit placed between the equipment and the antenna. Such filters are far from new, they have been described on a number of occasions. These have been made of tin cans, brass tubing, or aluminum tubing, yet they all had one basic structure, they were coaxial capacity loaded quarter wave lines. This is, of course, a simple case to compile mathematically, and a relatively familiar mechanical structure. Unfortunately, I don't have a lathe in my basement, I dislike using blowtorches, and I haven't found an easy way to solder aluminum. Further, and most important from a lazy man's point of view, I always assume there should be an easier way to do the job.

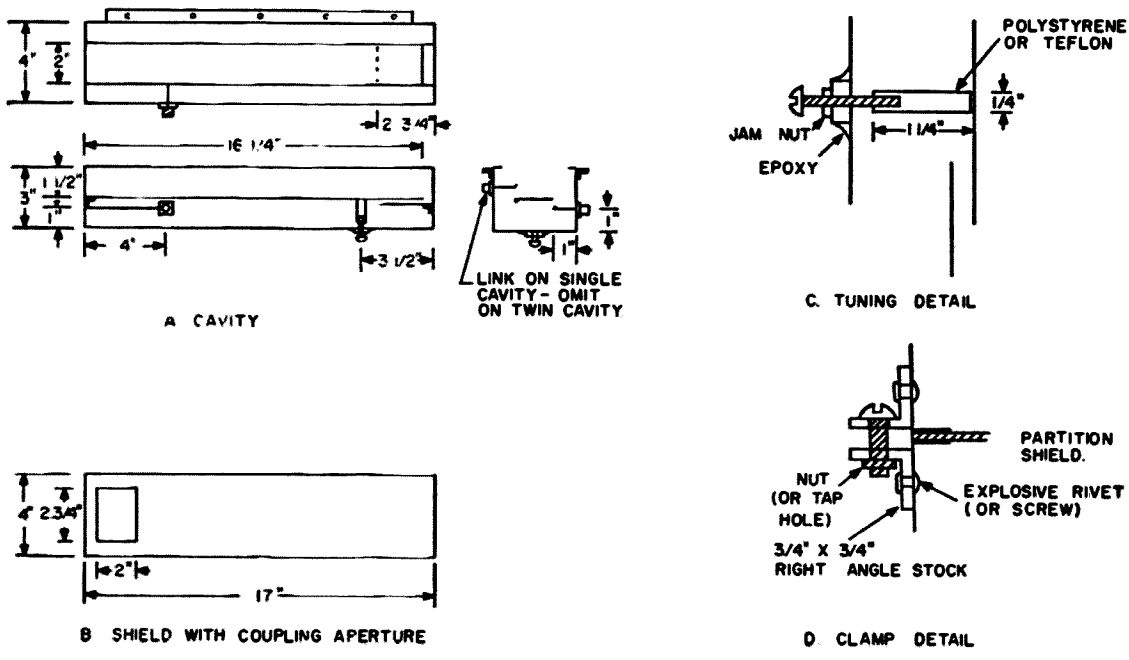
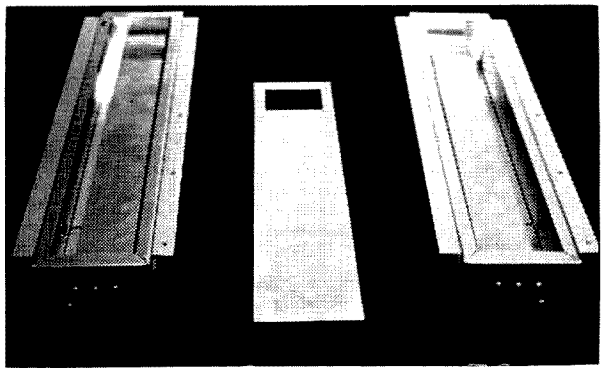


FIG. 1



Inside View—note that the aperture is at the wrong end, it should be at the cold end.

The result, after going to a number of reference books on the characteristics of various transmission line structures, was to use a strip line in a rectangular enclosure. Complete dimension details are given in Fig. 1. The enclosure is a simple structure, a 3 x 4 x 17" aluminum chassis, which is a standard item available from the local distributor. The center strip is simply a 2" wide piece of aluminum, 16¼" long mounted by using a 2" length of aluminum right angle stock. The thickness of the piece is not important, the width, while not critical, was chosen to give the optimum Q for this structural configuration. Another piece of 2" wide strip, 2¾" long, is mounted on the other end of the chassis, and is positioned about ¼" away from the center-line. This piece furnishes the capacitance to tune the line to resonance. Tuning is accomplished by the simple expediency of controlling the distance between the main strip and the capacitor plate. To accomplish this a hole is drilled 3½" from the end of the chassis. Either an extra thickness of aluminum is placed there and the total thickness tapped, or, if you don't have a tap, merely remove the bushing from a slug tuned coil form and put this in the hole.

The technique used in our units was to cut a square piece of ¼" thick aluminum and bond it with epoxy. A piece of polystyrene or teflon rod about an inch long is used for tuning. This rod is drilled about ⅜" deep and tapped for the tuning screw. The screw is one inch long and is inserted and the insulating rod screwed on. (See detail in Fig. IC.) The tuning is accomplished by pushing the strip away from the fixed capacitor plate. There is enough spring in the line to bring the strip closer to the plate. It can be easily bent for proper action.

This tuning technique has the added advantage of economy; there is no necessity for

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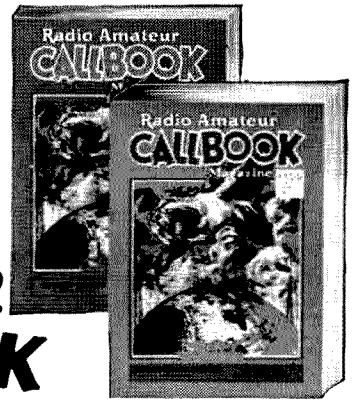
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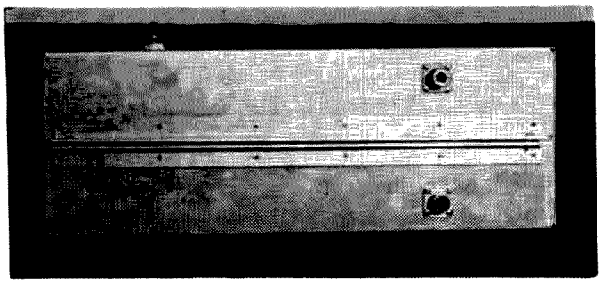
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Side View—only two clamping screws are in place. Actually five are used, the remainder were not replaced by the photographer.

purchasing a fancy disc neutralizing cacpacitor and dissembling and remounting the disc to tune the tank circuit.

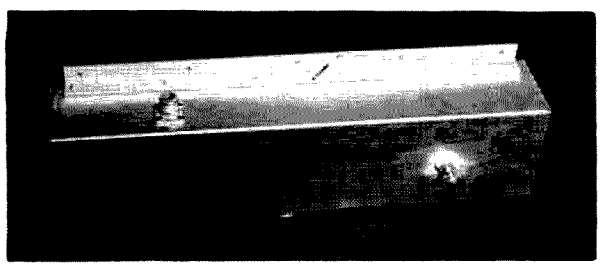
The coupling links are made of 14 gauge wire to coaxial sockets placed 4" from the end of the enclosure and 1" from the side. These are placed on opposite sides of the strip line and on opposite sides of the chassis to minimize capacitive coupling. The wire is run about 1¼" in from the side of the enclosure and the screws to connect the ground end of the link are drilled 1" from the sides and 1" from the top and 1" from the top and bottom respectively. This gives a good match to 50 ohm line, if you use 72 ohm line make the link longer. A 4" x 17" sheet of aluminum is used for a cover to seal the cavity.

The next logical step is based on the old proposition that if one is good, two are better. With two instead of one you can either have greater selectivity with optimum coupling, or, if broader coverage is required, they may be broad-banded by overcoupling the units, while still doing a fine job of removing birdies.

The dual unit is easily built, two identical units are constructed with only one coupling link in each. This link is placed on the side of the strip closest to the chassis top. 16" strips of right angle stock are mounted on the bottom edges of the chassis (actually done with explosive rivet, but screws should do nicely) and holes are drilled so that screws may draw the bottoms of the two units tightly together. (See detail in Fig. 1D.) A thin sheet of aluminum 4" x 17" is placed between the two units and forms a common wall between the two filters. A rectangular hole 1½" x 2¾" is cut near one end of the sheet. This gives approximately optimum coupling. Larger apertures may be used if overcoupling, and thus broadbanding is desired. Since the partition is merely a thin sheet of aluminum stock held in by compression, it is quite feasible to have two sheets, and by merely loosening the screws, remove one sheet and replace it by another, as required. The aperture should be at the cold (link) end of the cavity. The second aperture we use is 2" x 2¾", which we found satisfactory for general purpose use. Those who use a larger portion of the band than is in general use in our area might find even larger apertures desirable.

The photographs of the unit give further detail of the construction. The two different coaxial connectors have caused comment and I carefully explain I had a requirement for these two connectors—and I must confess they were luckily the only two in the junk box at the moment. Note the position of the shield in the photograph. The aperture is at the wrong end—these things happen when you aren't around when the photographer goes to work.

As to actual performance characteristics, we don't have a laboratory at our disposal, but with considerable difficulty we measured response of — 45 db at 125 mc and —70 db at 165 mc. The insertion loss is about .3 db with the smallest aperture and less with the larger—so small the fellow at the other end will never miss it.



Top Detail—the five clamping screw holes are shown and the tuning screw detail is shown.

The end product is a high Q resonant filter which is constructed of readily available materials and needs no tools more exotic than a hacksaw! In actual operation it has effectively disposed of the effects of a local FM station (3 blocks is local and then some!) and a TV sound birdie I used to swear at. It has been tried at other locations and does an effective job of eliminating an assortment of unwelcome intruders.

Lest you jump to the conclusion that it is a cure-all for the entire range of birdies, it unfortunately does nothing for offending signals which do not come in via the coax from the VHF beam. You still need effective shielding between the converter and the receiver, for no amount of pre-converter filtering will help if the signals are coming into a poorly shielded receiver. Another point on birdie elimination is to use your low frequency high pass filter between the VHF converter and the station receiver. This helps keep harmonics of the receiver oscillator (or oscillators) out of the converter.

. . . W3TUZ

Treasures in the Junk Yard

Floyd O'Kelly W5VOH
418 E. Hickory
Midland, Texas

WOULD you like to have a good quality broadcast receiver with excellent sensitivity, selectivity and stability, plus a fine push-pull audio output—for ten to fifteen dollars? This may seem like quite an order, but you can find these bargains piled abusively in the corner of one of your local automobile wrecking yards. These unfortunate victims of our modern society are the automobile receivers that were removed from the mutilated bodies of discarded cars.

"That's all well and good," you say, "but I've already got a radio in my car—what do I want with another one?"

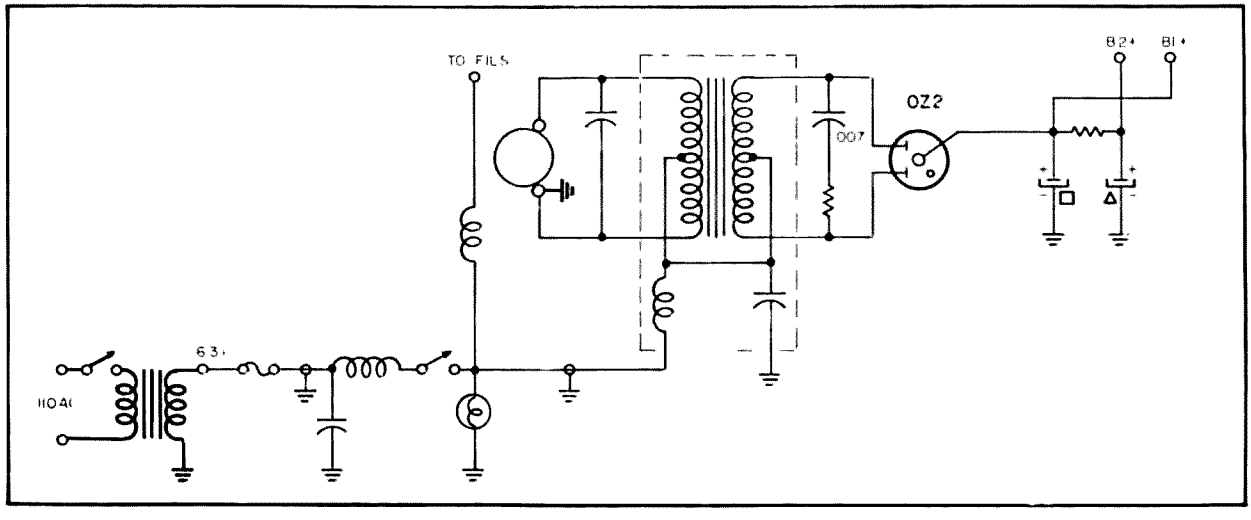
These ruggedly constructed units that perform so faithfully under the extreme conditions associated with mobile operations, may be retired to the home or shop and converted to 110 VAC operations in about five minutes.

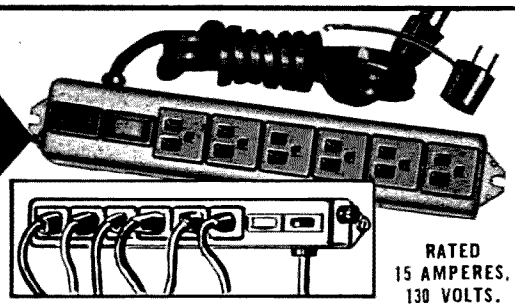
"Why bother with all this converting jazz when for about $19.95, I can get one of those new plastic case jobs down at the corner drug?"

I believe you can answer your own question if you will make an eyeball comparison of the construction and schematic diagram of a popular ac-dc receiver and auto receiver. Besides having tuned rf amplifier stage (almost unheard of in the ac-dc sets), and selectivity from the 262 kc *if*, most automobile receivers have a good push-pull audio output. I have priced these units across West Texas and find they cost as little as a "saw-buck" to about fifteen dollars each—depending on condition, age, type, and whether it is still in the car. The one I have was removed from a 1951 Mercury and was purchased for $1.50. It would not utter a sound when we tried it at the wrecking yard, but after examining and smelling it for a while, I parted with my buck-fifty, tucked the dusty box under my arm and headed for the nearest service station to blow the dust and crud from my prize.

Troubleshooting disclosed that only a burned out 6SN7, OZ4 and vibrator needed replacing to restore the unit to its original condition. And, using a battery eliminator as a six volt source, I let it play for a couple of days to see if anything would break down.

It became apparent that the battery eliminator was fine for test purposes, but was not the most convenient arrangement for a permanent installation. The general consensus of opinion from the local "electronic experts" was to remove the vibrator power supply and replace it with a conventional 110 vac power supply. But finding a transformer that would fit in the allocated space seemed to be an impossible assignment. I had resorted to constructing a complete external power supply when I got into a discussion of the problem with my good buddy Ike Searles W5SMJ. Ike



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felt that the six volt-one hundred cycle power transformer probably had enough iron in it to handle a 60 cycle power source, and all that should be necessary would be to apply a six volt ac supply across half of the vibrator transformer.

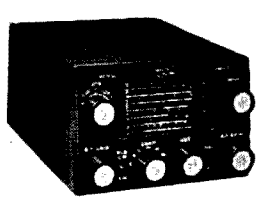
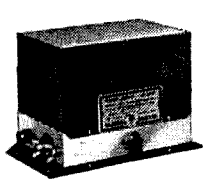
A quick look at the basic six volt vibrator power supply schematic showed that the function of the vibrator was to switch six volts dc between the ends of the primary of the high voltage transformer at approximately one hundred times a second and make the transformer believe it's looking at a six volt ac source. It was obvious that all that was necessary to make the vibrator transformer operate would be to place a six colt ac source across half the primary. This conversion is very simple. Remove the vibrator from its socket, ground one of the small pins on the vibrator socket, connect one lead from the secondary of a six volt transformer of adequate current rating to the receiver power input line (usually around six to eight amps—the one I used was an old TV transformer that had an open high voltage winding) and ground the other six volt transformer lead to the receiver chassis. Plug in the primary leads to a 110 ac source and sit back and enjoy reception from a receiver that will compare to one in the $75.00 or better class.

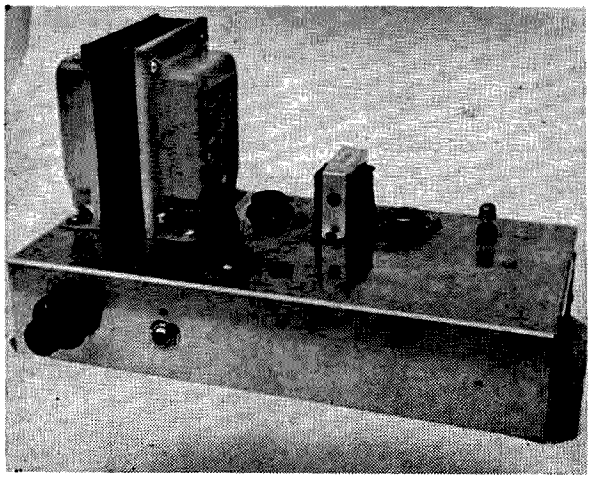
Norm, W5GOS, made the above conversion, placed a converter on the front end and used it as a portable ham receiver. I have assisted several of my non-technical friends convert and install these units in cabinets, kitchens, bed headboards, etc., and to date no problems have resulted.

So, if you are looking for a second receiver, a conelrad monitor, or a portable rig, try this simple conversion and I believe you will be as pleased as I am with mine. . . . W5VOH

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Lester Earnshaw VE7QL
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A Low Current, Slide Bias, Modulator

TRANSISTORS have been with us long enough now to have found their way into most AM mobile equipment, especially in the audio department. Although this has resulted in a major saving in battery current, no one is adverse to even greater savings. This is especially true when the increased saving is effected without further circuit complication.

The modulator described below delivers 40 watts of audio to the load. Yet, during the no signal condition, total current drawn from the battery is only 250 ma!

The microphone pre-amplifier consists of a Motorola 2N1181 which is connected in the common emitter configuration. This stage should be driven by a dynamic microphone. If a ceramic or crystal microphone is preferred it will be necessary to insert a matching stage between the microphone and the pre-amplifier. Transistors other than the 2N1191 may be used without circuit alteration. Those tested and found satisfactory were the T.I. 2N1381, the Philco 2N1478 and the RCA 2N408.

The 2N1191 drives a class A Motorola 2N555. The 2N555 is a very inexpensive experimenter type transistor. Other equivalent transistors should give similar results. The 2N555 stage has its bias controlled by the following class B modulator stage. As the signal level increases so does the bias on the 2N555 stage increase. The 4.7K forward bias resistor allows a small bias current to flow so that the transistor is operating class A even for small signals.

Following the sliding bias stage are two Motorola 2N1554 transistors. These transistors

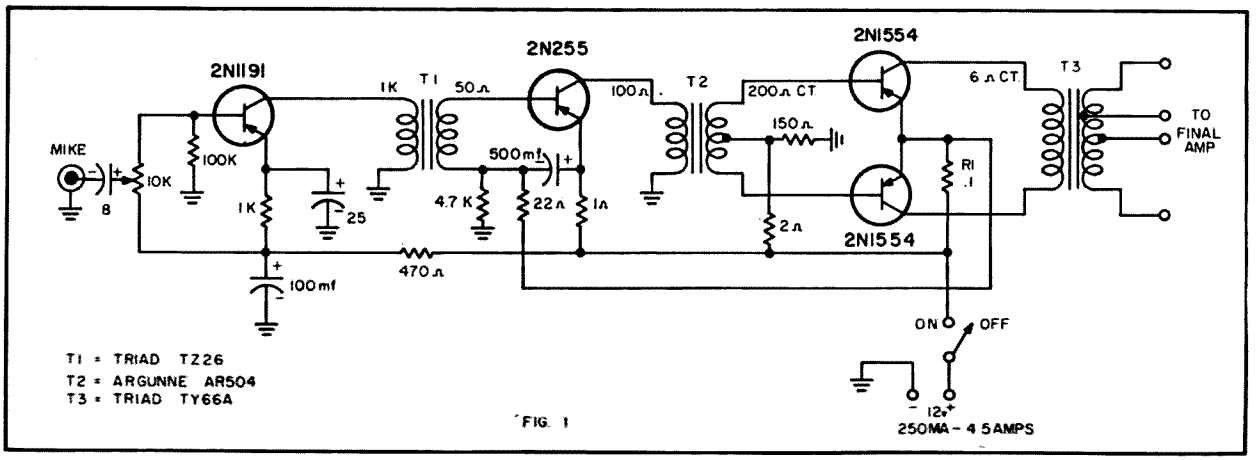


FIG. 1

40 Ft. CRANK-UP TOWER

At

68 MPH

*At 40 Feet

USING A TRI-BAND
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Assembled Weight—20 lbs.
Wind Surface Area—4.9 sq. ft.
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Boom Length—12'
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are excellent for this purpose which is something that cannot be said for a good number of other transistors. A perusal of the 2N1554 I_c–E_c curves show that the transistor has very even spacing between the base lines which indicates that the 2N1554 is capable of excellent linearity. If other transistors are substituted, only those with good linearity characteristics should be used or distortion will result. Another Motorola transistor which gave excellent results (although a smaller transistor) was the 2N1540. If full output is required from the modulator, the builder is advised to stick with the 2N1554 even though it does cost more.

The required output transformer impedance is determined from the formula:

$$R_L = \frac{2\ (V_{ce})^2}{\text{Power out.}}$$

Where V_{ce} = collector to emitter voltage.

Example. $R_L = \frac{2 \times 12^2}{50 \text{ watts.}} = 5.8 \text{ ohms.}$

Note that the transformer impedance is calculated to allow 50 watts of audio to be developed. The reason for this is that approximately 10 watts is lost in the transformer. The closest available transformer was the Triad TY66A.

It is pointed out that it will not be possible to develop 50 watts of audio across the primary of the transformer unless the secondary is properly matched. The transistors "see" 6 ohms only when the transformer secondary "sees" the correct load. An incorrect secondary load will reflect an incorrect primary load.

As the class B modulator is caused to draw current (simply by speaking into the microphone), so is a voltage dropped across the emitter resistor R1. This voltage is *negative going* in character and thus, when applied to the base of the driver through the 22 ohm resistor, causes an increase in 2N555 collector

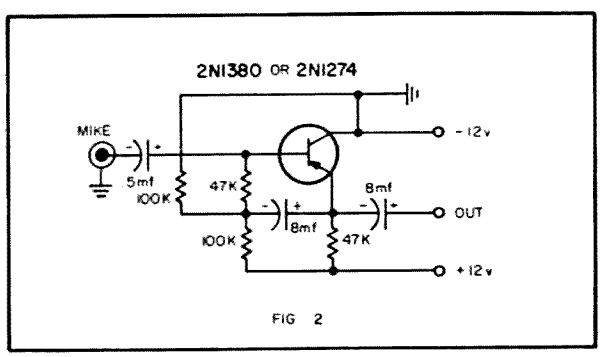
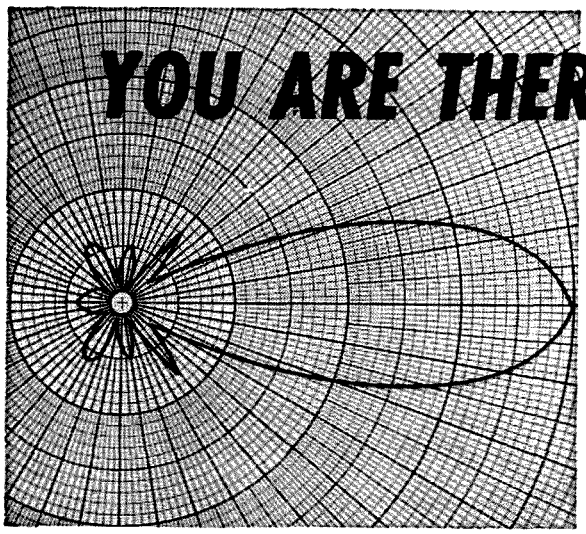


FIG 2



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current. The 2N555 current increases from approximately 50 ma at no signal to approximately .5 amps at maximum signal.

Total current drawn by the modulator during standby is approximately 250 ma. This value will change 20% or so with changes in temperature. If necessary, the 150 ohm forward bias resistor may be raised in value to effect a decrease in the standby current. However, unless a compensating thermistor is added to the circuit, cross over distortion is likely to occur during cold weather.

Maximum current on voice peaks will be between 4 and 5 amps.

A 0.1 ohm resistor is not normally available from a supply store. However, the resistor is easily fabricated from a piece of resistance wire or even copper wire. If the latter is used the correct length may be obtained from a wire table.

The transistors should be firmly mounted to the chassis but insulated from it with mica washers. The chassis should have a reasonable area to dissipate heat generated when talking. Don't forget to remove the burrs from the holes before bolting the transistors down. A piece of fine emery paper wrapped around a flat ruler and rubbed over the area will effect the greatest amount of burr removal.

A suitable matching stage for use with the crystal or ceramic microphone is shown in Fig. 2. The stage may conveniently be mounted in the microphone case if desired.

. . . VE7QL

Amateur Radio Regulations in the U.S.S.R.

January 1962 issue of "RADIO" (published in Moscow) has the following information: There are three kinds of registrations; beginners (3rd Class) are permitted to use 3.5-3.65 mc and 7.0-7.1 mc telegraph only, max. power TEN watts. Phone and CW is permitted on 28.0-29.7 mc (ten watts) and 144-146 mc, 420-435 mc (5 w), 2nd Class is permitted to use in addition 14-14.35 mc, CW with a power of 40 watts on all bands except VHF where it remains 5 watts.

1st Class gets another addition, 21-21.45 mc, power goes up to 200 watts, and both phone and CW are permitted. The VHF, however is still 5 watts.

There is a considerable Red-Tape involved in getting the ticket; several offices have to be contacted, questionnaires filled, photos enclosed, and even "character report" from the place where you are working are needed. Also needed is a complete diagram of your future station, and you can start building it only *after* you receive the license. Examinations are necessary for all groups. . . . K6BIJ

How's My What?

Edwin Cole W7IDF
P.O. Box 3
Vashon, Washington

THE June issue of 73 pried into my public life with the question "How Is Your Ham Image?" and I promptly fell into a deep sleep. Hours later, my aplomb restored, I clipped a ground lead to my identification bracelet and carefully read K7NZA's disquieting series of examples and admonitions.

Well aware that self-analysis can be painful and invite depressing conclusions, I encouraged myself with the thought, "I'm doing this for my country." Shifting the brain down for hill-climbing usually means clapper-valve trouble in the tummy for me, but "Green's Principle" is a comfort: "Think gently; if you detect elements of great issues stop thinking instantly." This rule has served well to protect my peace of mind and has kept me from learning much about anything—two ways of saying the same thing, really.

After reflecting on what K7NZA had to say I turned for comfort to the June issue of Harper's, a magazine of equivalent calibre in its own field. There I found "Stop Worrying About Your Image" by David Finn, president of Ruder and Finn. Mr. Finn has been selling Image Kits for years to the big operators who mass-produce good things for us, like tail fins, Betsy Wetsy dolls and ugly commercials, and he explains and deprecates his subject with guilty facility. His concluding advice to the bemused iconophile (in this case you and me) is simply, " . . . he should stop worrying about his image altogether and concentrate on finding himself."

Know himself would be more to the point I should think, but be that as it may when Harper's and 73 meet head-on we follow Our Leader, don't we? So I kept right on sulking about my Ham Image until it occurred to me that such shortcomings as those in the 73 article are really only symptoms of a more general failing. An echo down the years helped me to this conclusion, but more about that later, I'm afraid. My point is that we take ourselves too seriously as artisans and not seriously enough as members of the human race.

To the superficially curious non-amateur (most of us were, once) the sounds of RACES, MARS and other activities inspired by patriotism or simple sensitivity to community needs are just not distinguishable from the tired inanities, contest numbers, DX riots, AM-SSB needling and rollicking roundtables. As individuals we sound incomprehensible; as funny license plate types, we seem to be a phenomenon of the electronic era with a common hunger for more and wider kilocycles. These we want for sending code, chatter (English and sideband), telephoning from cars and running spooky typewriters.

The listener who is too bored or discouraged to pursue the subject might reasonably conclude that our only distinction is a rather pointless virtuosity with our little black boxes. The inference follows that licensing and regulating our operations at public expense is equally pointless, or worse. Although community services, disaster communications nets and phone patches from servicemen to their families are demonstrations of our value that would change such an opinion, as evidence they are overwhelmed by the nonsense on the air. Most of us are aware of this image and we know we can polish it up, but there is another and more serious picture.

Even in our purview recognition of the radio amateur as a veritable human being possessing

imagination and intellectual awareness of the influence of his art is rare. Trace elements of international inflection turn up in 73 editorials, evidence that one editor is gambling that our minds have breadth as well as length, but in our journals generally this is a rule observed mainly in the breach (a literary phrase from the June issue of Collier's). The narrowness of scope, editorial inertia and prolix re-hashing of worn ideas in too many issues suggests to me that we are regarded as communication-oriented readers with spines topped by small knobs.

Hopefully I submit that we can be thoughtful about ends as well as means, although the means have been getting all the attention. Consider the potential good of diverting to more productive channels the constant wrangling over filters, modes, linear efficiency, etc. All the answers are in the books, but we fight it out anyway, expending time, airspace and temper usually to fall through the ropes into ambiguity or error. We get deadly serious, and deadly tiresome, for example, about a subject like SSB. Actually there is nothing new about the concept, and nothing to justify our ridiculous quarreling—but if we didn't argue about someone else's ideas we would have to get some of our own. But did you know the discovery of SSB antedates Marconi, Popov and West Hartford? It seems that when the British first sailed to the Treaty Ports of China with empty bottoms and a hunger to fill them with silks and tea, a serious difficulty faced them. How to bargain for the best possible prices with merchants speaking Mandarin, Cantonese and Samshu brogue? One fortuitous day an Englishman was earnestly negotiating in gestures with an amused exporter and to no avail. Eventually one of his gestures misfired and he was taken behind a godown and severely beaten, but that's another story. Before this happened there was a moment when the two principals were standing at an impasse with the Chinese gentleman wondering aloud why the English had such long noses, when a passing urchin whistled a melancholy air. Instantly the Chinese speech was intelligible to the foreigner, although he later remembered there seemed to be a bit of background garbling. At his first opportunity he hired a boy to accompany him on business trips and taught him to crouch behind a tical of tea and whistle softly during the conferences. After a few profitable years the Englishman retired to the South of France. Unfortunately the secret was temporarily lost when he succumbed to apoplexy while trying to inject an air of lucidity into a Basque political speech. Basque is double sideband—a system known to give the SSB men horrible fits.

French scholars brought to light the historical facts above, and if we weren't generally aware of them it is because of the intramural character of our journalism. Little news of the amateur community of foreign lands is published here, I might add, grumpily. And less consideration granted their members. Granted that letters from them are published, that we see snapshots of them in the DX columns and that concern is growing over such problems as cooperation on the DX bands and reciprocal licensing, too much is missing. Their letters are typically legitimate gripes about our members on the air; the captions under their photos are significantly less than expansive: "José Duarte, 90 watts on twenty, three element beam." Sometimes the editor goes overboard and mentions the receiver. If our interest seems almost clinical at least in this area we don't discriminate—the same exciting captions may be found under photos of the home team in other columns. But to continue—on the reciprocal licensing question they've been giving and we've been taking; in the DX slots we have the mass and power; they learn English and occasionally we have the grace to compliment them. In English of course.

Now and again we show our interest by mounting an expedition to a quiet corner of some far country courteous enough to grant visitors a license. The communications effort that results usually demonstrates technical prowess on that end, some surpassing boorishness on this end, and how silent the band can get ten kilocycles offside. I'm sure the traveling Americans who have the initiative to carry out these projects make good impressions individually, but I doubt the citizens view the operation as anything more than a cryptically satisfying activity of Inscrutable America. If, indeed, they are aware of it at all.

Writing as a non-participating ignoramus in these matters, I wonder if it wouldn't be possible to provide a foreign ham or ham club near the target with expense funds and some equipment to do the job, rather than ship the stuff and people from here to there and back again? Perhaps it wouldn't be practical but there is a measure of madness in our fabric anyway, and practicality is the foe of pleasure otherwise parties would break up at midnight in favor of early morning gardening. It's never been my privilege to work a DXpedition, or contribute to one, but if they could be set up this way I'd be inclined to chip in and hope

George would come out of it feeling adequately compensated by the shattering experience and the extra gear. Well, it was just a friendly suggestion, and fortunately there are others around to choose among, such as K6BX's plan to help you send your extra Callbooks overseas and the International Ham-Hop Club Wayne has mentioned in his Porsche department.

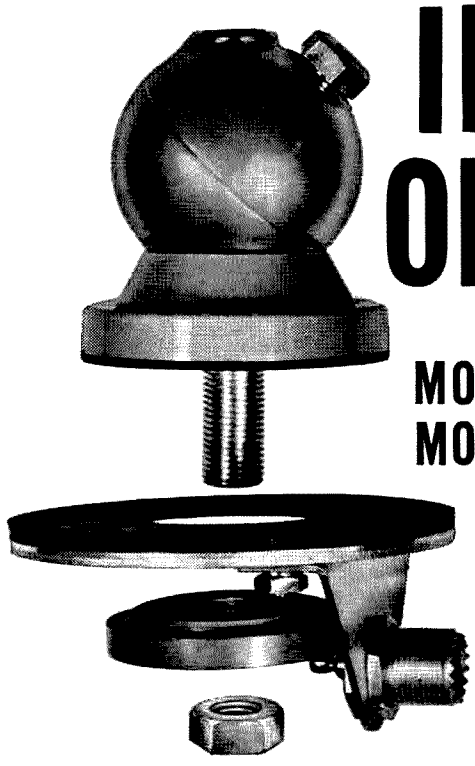
Making friends is important, like breathing, but in times of world crises when it would mean the most it comes under a cloud. The barricades that rise men have seen before, but the cloud is unique and while there is time to improve the American Image we had better get at it. It is our distinction, as radio amateurs, that we have the means to help, and it shouldn't take much soul-searching to see the obligation implicit in our franchise.

Consider this profundity: One way of improving relations with people is to be friendlier. Yet the conventional DX contact is brief and sterile. With us unsophisticates the average QSO with a foreign ham takes a few minutes to run the scale from embarrassingly eager to embarrassingly taciturn. If conditions or congestion interfere we can do it in half the time. And the pros on the long-haul circuits aren't much better. Most of them sound slick and laconic and give the impression that their attention is focused on a spot above the other fellow's left shoulder, or on the next country. In these conversations the preliminary exchange of names, locations and tube size normally is followed by an almost audible mental block, a hearty anticipation of future contacts and a diffident goodbye.

If we can't achieve the status of the tail-coated ambassadors it won't hurt to remember that military cemeteries around the world bear witness to their smashing success as couriers of good will. They could use some help and all we have to do is flip a switch to enter the homes of men everywhere struggling to work out their destinies in a jumpy world. Moreover in the skies we travel our laws make no reference to creed or color or economic status, and our privileged communications flow heedless as the wind over borderlines and battlefields. If this sounds rather grand and rhetorical it's probably my sense of personal involvement, and frustration, bugging me. We are all mortals running out our span of years in mixed moods and circumstances, commonly afflicted with corns and taxes, generally content to search for happiness in the achievement of reasonable ambitions. Individually we want peace and justice; nationally our govern-

(More on page 71)

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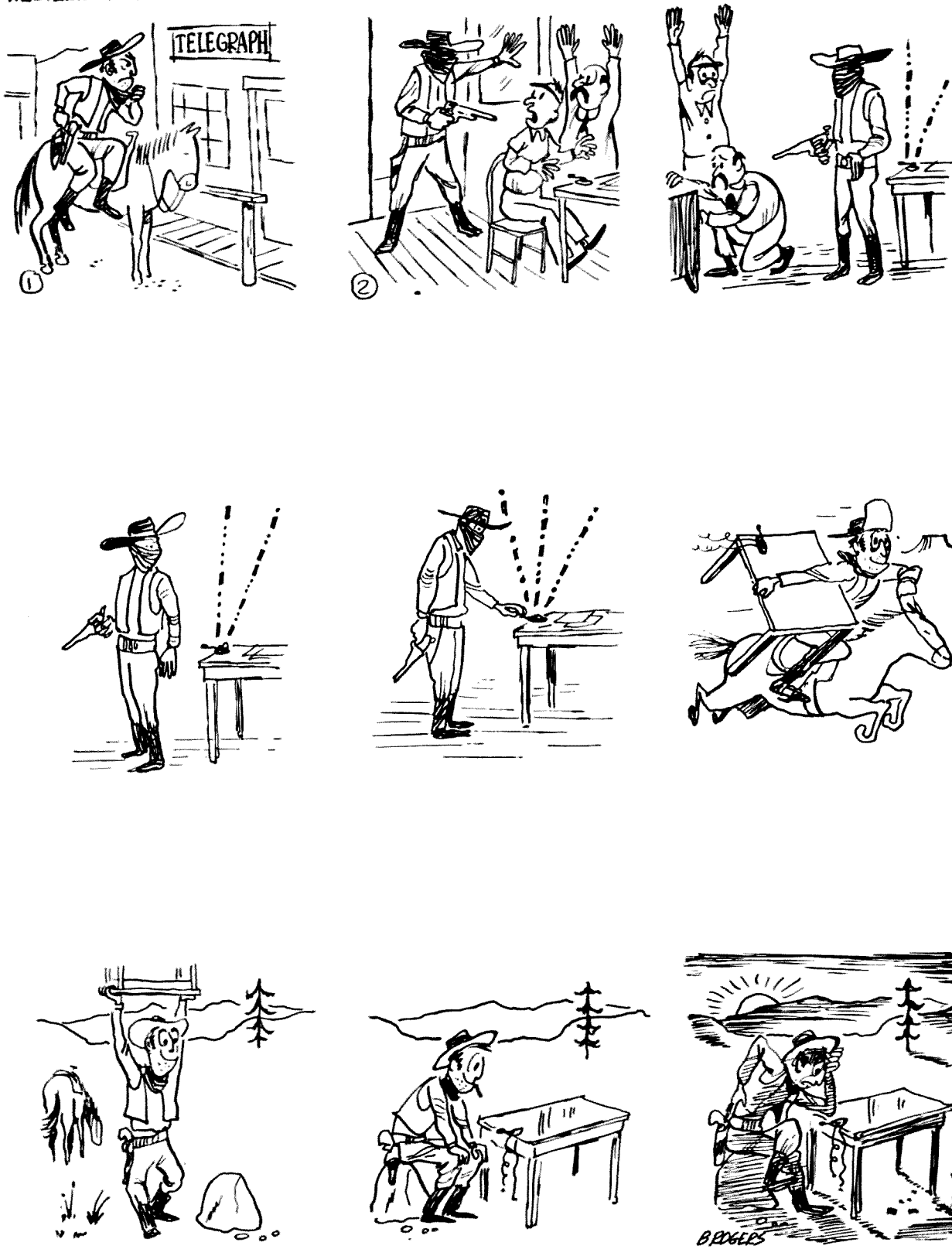
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WESTERN HAM



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Paul Barton W6JAT
14666 Berry Way
San Jose, California

GROUNDED grid linear amplifiers have been popular for some years. The reasons are varied and numerous.

Many hams originally went to grounded grid for reasons of stability. Due to the relatively high drive requirements, a grounded grid stage is less prone to driving itself (taking off) from stray feedback. Of course, at any frequency that the grid is not at ground rf potential, the stage is no longer a grounded grid stage, but an unneutralized rf amplifier or, more likely, an oscillator. So great care must be exercised to be sure the grid is truly grounded for all the frequencies involved—usually to about 100 mc for 2-30 mc work.

Grounded grid amplifiers are degenerative, which, like inverse feedback, makes for better linearity. Pentode and tetrode tubes are not as linear in their characteristics as a good triode can be, but have better gain capabilities. A grounded grid tetrode with the usual plus voltage on the screen (preferably clamp tube controlled) can have linear characteristics approaching that of a good triode but better gain than a triode.

Examination of Fig. I reveals that a grounded grid amplifier presents only a half wave load to the exciter, due to the diode action of the amplifier tube from cathode to grids. This means the exciter is not loaded on the positive peaks of excitation and results in exciter distortion, which is then amplified by the final.

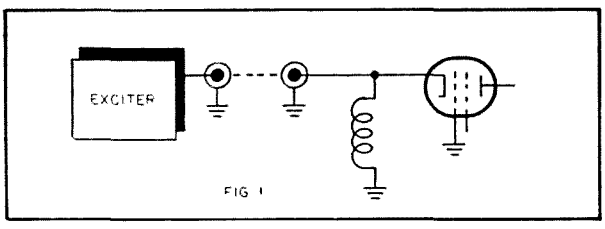


FIG 1

This distortion is not a high order of distortion. It is probably below the level that can be detected by ear, but is very real when low order distortion products are important.

For instance, in commercial applications, where both high and low sidebands are being used simultaneously for separate communications, the distortion products from the opposite side band should be down not less than 60 db.

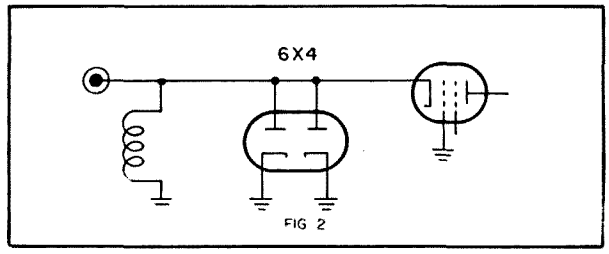


FIG 2

Preferably much more. At 6 db per "S" unit, a common figure on communications receivers, a 30 db over S-9 signal with 60 db suppression would have S-4 distortion products on the other side band. This might be tolerable in critical work but only barely so.

Some commercial applications have found grounded grid unsatisfactory for this reason. In at least one instance (not limited to a KW input) they went to a high powered class "A" amplifier to get away from diode distortion.

On today's market are numerous fine SSB exciters having 50 to 100 watts output. Dissipating this power into the cathode of a grounded grid stage is a natural, and is one of the reasons this is often done. But this can spoil the otherwise excellent suppression of a good exciter. The Collins KWM-2, etc., is an excellent example. This could be used to drive two 4CX300A tubes in parallel in grounded grid. However, instability and TVI in the exciter have been commonly experienced when

this was tried. (This is strictly the voice of experience speaking. Please pass the aspirins). This has been experienced in four separate rigs to this writer's positive knowledge.

At the Jennings plant the amateur station (K6LSZ) is happily presided over by "Buddy" Alvernaz W6DMN. Over the years Buddy has solved many a knotty problem. So this problem was presented to him, and he figured it out in jig time. Neither the writer nor Buddy is aware of anyone else having done this same thing, so it may be a "first."

The solution is really quite simple. Add a diode to rectify the other half of the cycle. As yet no solid state rectifier has been found that is good for rf and will handle the power so a 6X4 was used. No doubt there are many other rectifiers that will do the job, but the 6X4 works OK.

In Fig. 2 a diode has been added to the grounded grid amplifier. This should be wired in as close as possible from cathode to grid. The internal resistance of the 6X4 is low enough to match approximately the usual G-G tubes. The addition of this diode has reduced TVI and exciter instability in each case tried. It has been used in several KW 4CX300W linears, one ½ KW 811A linear and one

PREVERTER 50 & 144

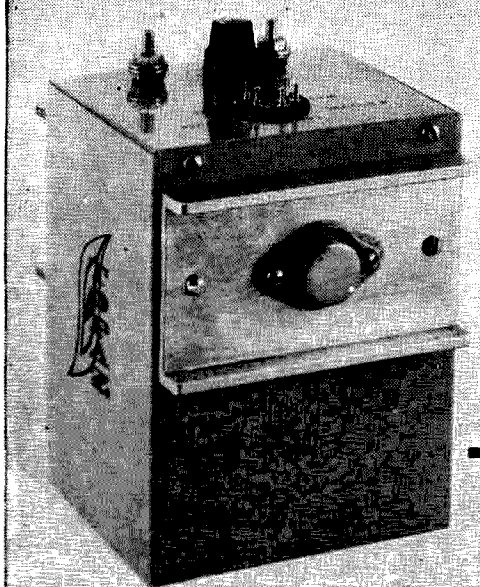


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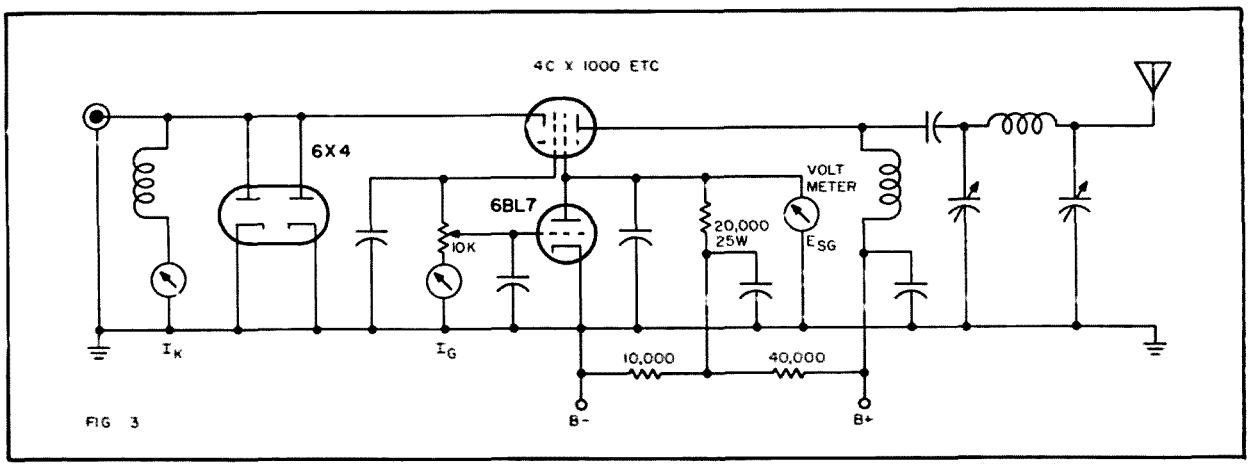


FIG 3

4CW2000 linear, all grounded grid. Strangely enough no more excitation is required.

Of course, a push-pull G-G stage would not require this treatment. Also, it is thought that it would be unnecessary if the Q of the tank circuit of the exciter was sufficiently great. However, this is seldom the case. A high Q tuned circuit at the cathode of the G-G linear amplifier would perhaps solve the distortion problem, but would add another control to the amplifier and would be difficult to switch in case band switching was desired. In fact, tentative calculations indicate this value of L & C to be impractical. An L-C with a Q of 30 and seeing a shunt load of 50 ohms would require 26,000 mmfd (.026 mfd) tuning capacity at 3.8 mc.

It should be noted that the 4CX1000 and the 4CW2000 are rated for zero grid current. A consultation with Eimac engineers reveals that there are excellent reasons for this restriction. Futher, this is a very outstanding tube for AB service. So no grid current is necessary or advisible. Notwithstanding however, at W6JAT a 4CW2000 has been in grounded grid, Class "B" clamp tube, tetrode connected, SSB operation for two years without difficulty. But a 10K grid leak is used to limit the grid currents. On voice, only a fraction of a milliamp of grid current is read on a 2½ ma meter. On tune up, this may go to 1 milliamps for a few seconds. Recently the 6X4 diode was added with the expected improvement.

Buddy has my thanks for another contribution to amateur radio.

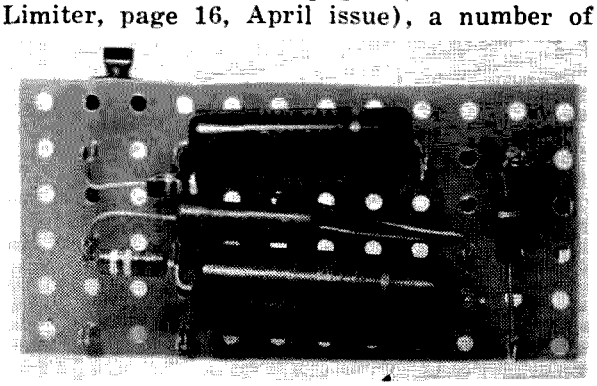
. . . W6JAT

The Rate-of-Change Limiter, Revisited

Or, How To Do It With Diodes

Jim Kyle K5JKX

SINCE the rate-of-change noise limiter was described in these pages (A *New* Noise Limiter, page 16, April issue), a number of readers have asked about the possibility of using crystal diodes instead of the vacuum tube employed in the original design.

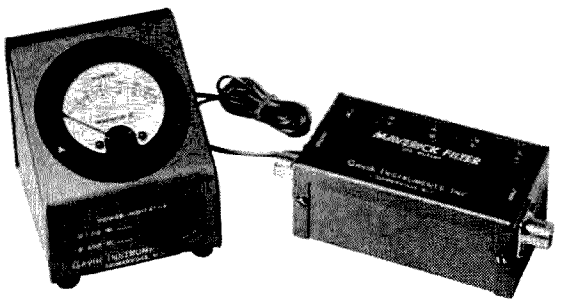


Despite the negative answers given to the original questioners, it *can* be done—and inexpensively, too! See the photos for proof.

The only objection to crystal diodes in a noise limiter at any time is that most common types have too little back resistance to limit properly. This is especially true of this circuit; the 1N34 and its relatives not only refuse to limit properly, they distort the audio beyond recognition as well.

However, high-back-resistance diodes are available at a price. That fact, coupled with

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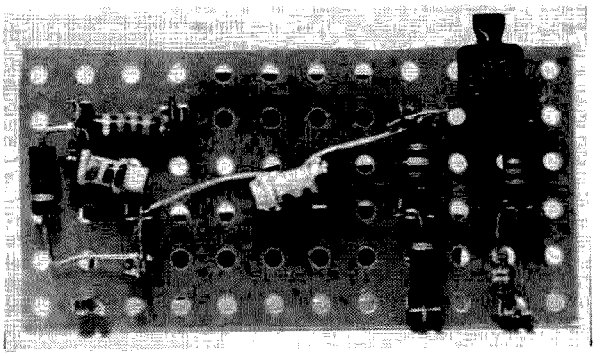
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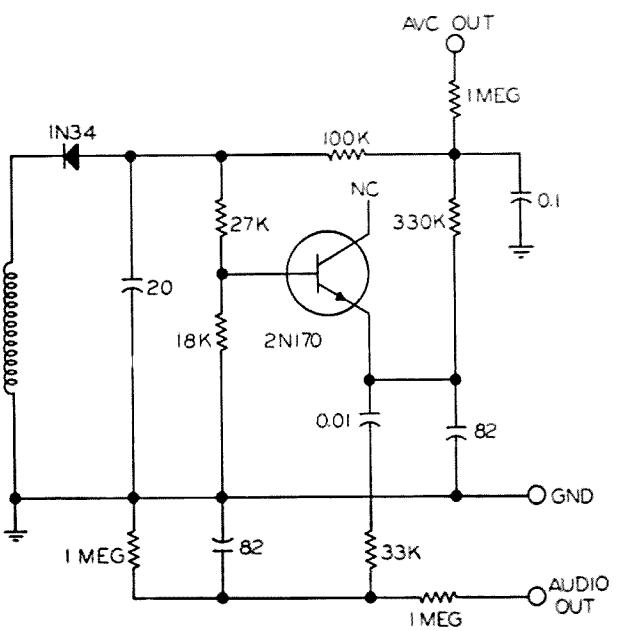


availability of a number of special computer diodes of unknown characteristics, prompted construction of the unit shown on a small piece of Vectorboard, followed by extensive experimentation.

Incidentally, the Vectorboard construction used here is ideal for such a project; the push-in terminals (Vector type 9.4) allow good connections to be made without soldering. This, in turn, allows easy change of components, yet the final working unit is ready to be installed. The unit shown in the photos is the actual breadboard—*not* a prettied-up copy built later!

Since the special computer diodes were available, they were tried first. The only thing this proved was that millimicrosecond switching capabilities and super-high-conductance don't necessarily correlate with high back resistance. Some of the units eliminated noise, but these eliminated the audio too. Others produced excellent audio, but emphasized the noise.

Just before taking $2 in hand and rushing out to buy a 1N497 silicon diode (reverse current ¼ *micro*amp at 50 volts!), an old but not-too-well known trick was remembered. You may have been wondering what the transistor shown in the pictures is doing in the circuit; the mystery is about to be unveiled. So far



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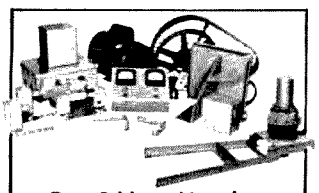
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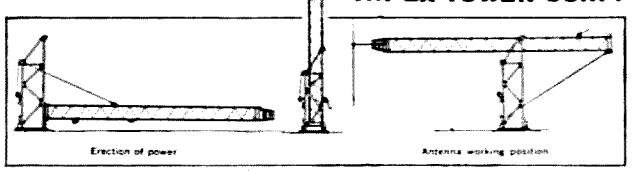
Tower Raising and Lowering and Rotating Unit for HZRN Series
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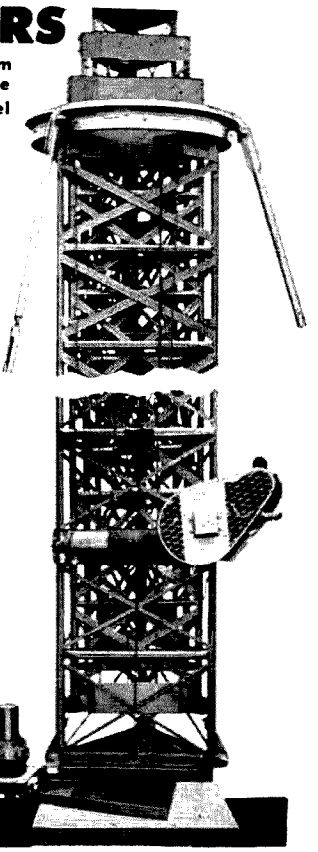
The new HZRN Rotating Tower is completely redesigned for smooth, frictionless rotating and raising and lowering. Featuring increased strength and greater weight, it meets and surpasses RETMA and UBC Building Standards.

The complete tower and antenna rotate on twelve large, sealed precision ball bearings at the 20' level, and on a heavy duty, flange type, self-aligning ball bearing at the base. No guying is necessary.

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Model	Height	Weight
HZR-237N	37'	510 lbs.
HZR-354N	54'	805 lbs.
HZR-471N	71'	1235 lbs.



TRI-EX TOWER CORP. 2920 W. Magnolia, Burbank, California

as this circuit is concerned, it's not a transistor at all—just a good noise-limiting diode.

It's inherent in junction transistor construction that the emitter-base junction has extra-high back resistance. Your only problem in making use of this fact is in determining which should be considered the cathode: emitter, or base.

The unit shown uses a GE type 2N170 NPN rf transistor; with the NPN transitor, the base becomes the anode and the emitter is the cathode. If a PNP transistor is used, the connections will be reversed.

How does it work? Happily, it performs at least as well as the original vacuum-tube unit, at a great saving in space. Tubular ceramic capacitors were used in the 82- and 20-mmf positions; even more space can be saved by substituting disc ceramics for the paper tubular 0.1 and 0.01 mf units too.

In addition to saving space, eliminating heater-power problems, and getting away from the associated problem of hum, this crystal-diode version of the rate-of-change limiter includes a couple of other features not found in the tube-type model. It provides AVC voltage, and allows you to retain the receiver's original volume control.

The original circuit, developed for use in TV sound channels where AGC is developed from video information, made no provision for AVC. However, the voltage across the 0.1-mf capacitor is suitable for AVC use; addition of the 1-megohm resistor as shown will isolate the AVC line enough to provide perfect operation. If slower release time is desired, capacity can be added to the AVC line, externally to the detector-limiter circuitry.

In the original circuit, also, the volume control value was fixed at 1 megohm; the limiter must still see a 1-megohm load impedance, but this is now provided by a fixed resistor across the output and the existing volume control is isolated by another 1-megohm resistor in series. The series resistor causes 6 db audio loss, but this is seldom serious.

For testing, the semiconductor limiter was installed in a vintage Super-Pro; the AVC line for the Super-Pro *if* strip was disconnected and reconnected to the limiter AVC takeoff. Under these conditions, 8 volts of AVC voltage were developed on the strongest signals; detector overload proved impossible; distortion was not detectable by ear; and, finally but far from least, ignition noise and other "sputter" went away as if a switch had been thrown when the limiter was cut into the circuit.

NOTE: Vectorboard and the type 9.4 terminals are available directly from Vector Electronic Co., 1100 Flower Street, Glendale 1, Calif., if your favorite distributor doesn't stock them. Write to Mr. Floyd Hill, general sales manager, and tell him you saw it in 73.

. . . K5JKX/6

Quad Mode Monitor

Part I of this article, published last month, went into details on the design and operation of this receiver. Now for the construction details.

John Wonsowicz W9DUT
4227 North Oriole Avenue
Norridge 34, Illinois

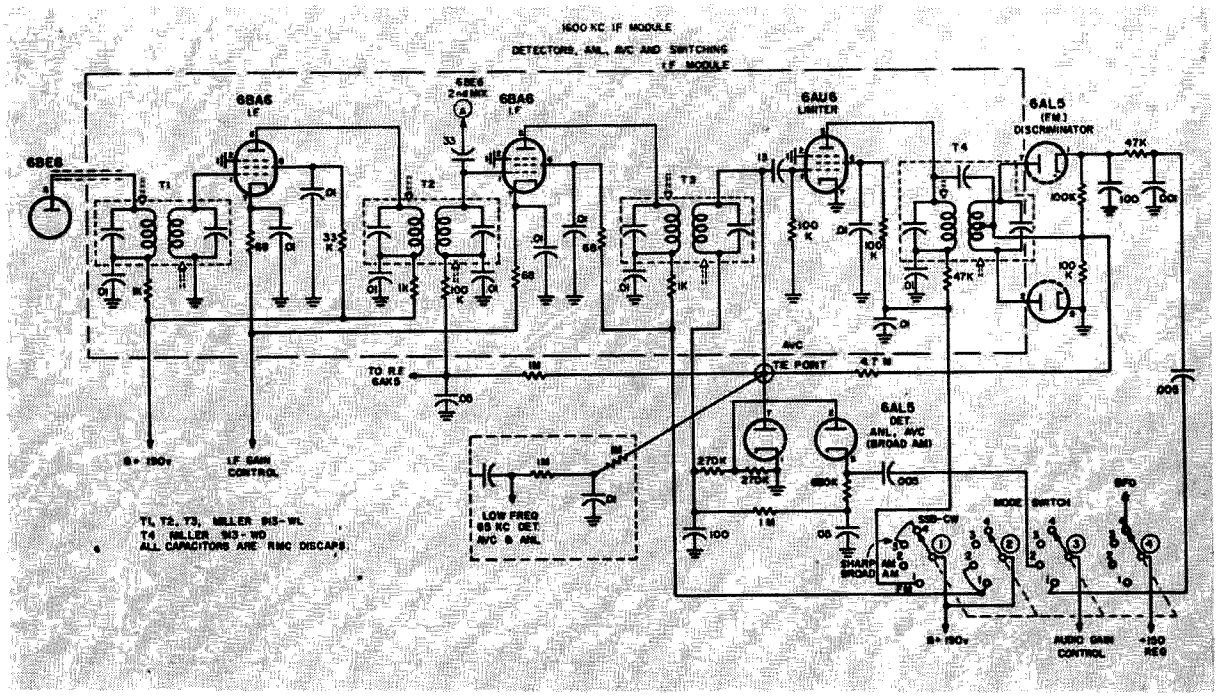
First *if*

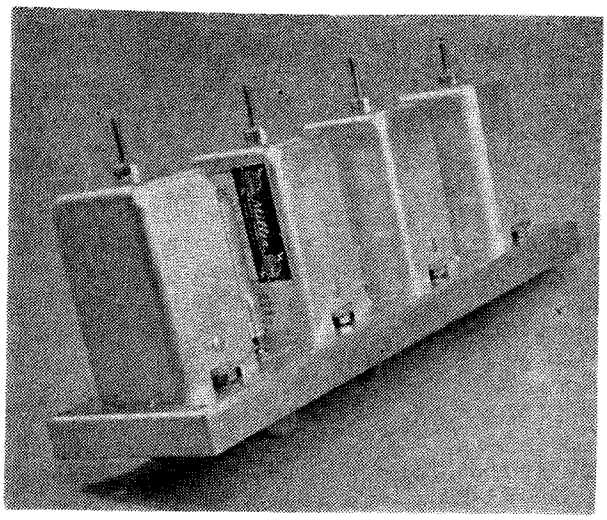
First module constructed after analyzing all associated circuits was the 1600 kc intermediate frequency amplifier. This unit was built on a aluminum chassis formed on a sheet metal brake and measures 2"x9½"x½".

Four Miller *if* transformers and three 6BA6 pentodes are used in this strip. The first three transformers, Miller 913-W1 tuned to 1600 kc, are the amplifiers and the limiter. The fourth transformer, Miller 913-WD tuned to 1600 kc, is the discriminator. Since high gain was required in this strip for broad AM mode, the above transformers, which are slug tuned, were selected due to their high gain and good stability.

In conversion to lower *if* frequency the signal is amplified through only one stage of 1600 kc and is coupled to the 6BE6 second mixer through a 33 mmfd NPO capacitor right at the grid of the second 6BA6 amplifier shown in the schematic.

To follow the broad AM signal further, let's look at the limiter stage. You will notice that the grid of the 6AU6 limiter is coupled to the preceding transformer by a 13 mmfd NPO capacitor, but the secondary of this transformer ties in to the 6AL5 dual diode, making it the AM detector ANL and AVC all in one envelope. This detector and tow high gain 1600 kc stages are used in the broad AM mode of reception. Now, switching to fm mode, the B+ is fed to the limiter stage and the audio from





1600 kc if Module: Aluminum chassis 2" x 9½" x ½." Three Miller 913-W1 and one Miller 913-WD transformers. Two 6BA6 pentodes as amplifiers, one 6AU6 limiter in this module. The 6AL5 discriminator is on main chassis.

6AL5 Foster-Seeley discriminator is coupled through the multi-mode switch into the audio amplifier. This 6AL5 is grouped with the three other detectors on the main chassis between the *if* strips.

A cut-out provided in the main chassis measuring 1¾"x8½" over which the *if* module is secured with 6-32 machine screws. In this fashion, rigidity was added to the main chassis and removal or addition of components in the module presents no problem. Peaking the button cores of the transformers is also accomplished through this cut-out.

As shown on the schematic, the circuitry is straight forward. However, keep in mind to make all grid and plate connections as short and direct as possible to prevent unwanted regeneration resulting from high gain. Also remember to bring out a lead from the junction of the two 68 ohm cathode resistors to the 5K pot on the front panel which is used as the *if* gain control. Since two of these stages can be biased highly with this system, overloading of this strip is prevented. After this strip was completed and tested, it was tuned to 1600 kc since that frequency seemed to be clear of strong commercial stations and then the *if* was shelved until the rf unit demanded it for tracking.

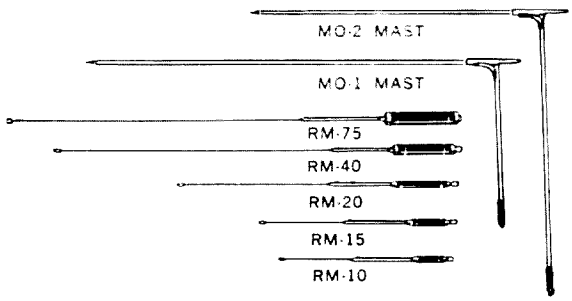
Front End

Now that a basic unit for tracking of the front-end is completed let's start on the "grand-payyp." As you have guessed, this module is most difficult, so extra precautions should be taken to achieve utmost stability, sensitivity and of course, good tracking. Therefore, to start off on the right foot, a rugged foundation should be used and nothing less than ⅛" aluminum plate should be considered as the base. The plate in this receiver measures 7" x 10" by ⅛" is of hard drawn alumi-

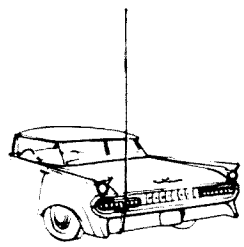
GOOD MOBILES GO

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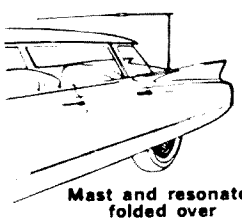
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Mast and resonator in mobiling position



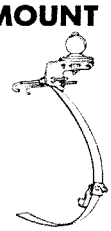
Mast and resonator folded over

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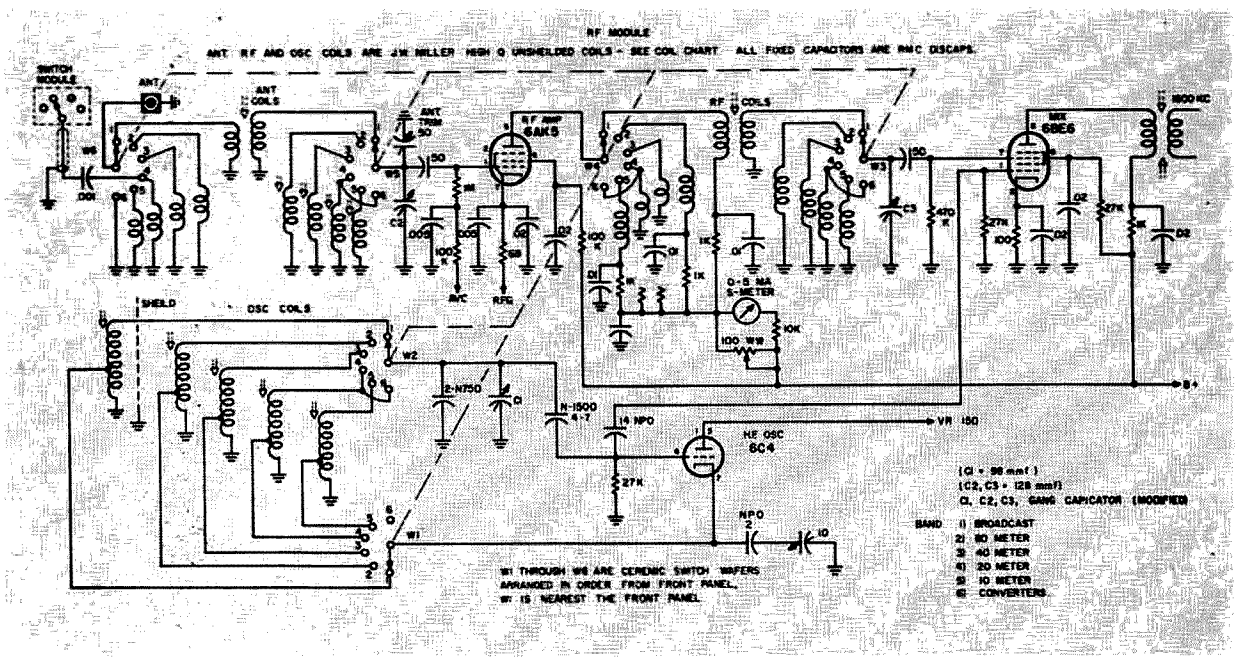
num to which right angle shield partitions were secured by 4-40 machine screws on the underneath side. These partitions not only add rigidity but also act as coil shields and serve as brackets for the ceramic band switch as seen in the photo. The switch was assembled from standard parts which are as follows: Centralab shaft assembly 302, six PA-1 single pole 2 to 12 position ceramic wafers and one type 31 phenolic wafer. The phenolic wafer is used in switching neon pilot lites on the front panel to indicate the band in use. Ordinarily this type of switch is not used in band switching communication receivers, but it worked out very well in this receiver.

If you have studied schematics of all band commercial receivers, you have perhaps noticed the difficult switching arrangement of wafers in a complicated assembly. Normally what is done is this; besides switching in different sections of the tuning capacitor, the unused coils are either shorted out or grounded, to prevent suck-outs and stray coupling. This is good engineering practice but a very confusing arrangement. Besides, a switch of this kind cannot be purchased over the counter, it has to be specially built.

The simple switch used in this receiver presented only one difficulty, but was immediately rectified by inserting a shield between the broadcast oscillator coil and the adjacent band two oscillator coil. What was happening is that the close proximity of the two coils created a suck-out on band two at about 3 mc. The reason was that the broadcast oscillator coil was self resonant at 4.6 mc and when a signal of 3 mc on band two was tuned in, the oscillator coil being at 1600 kc above the signal frequency was weakened by absorption of the adjacent coil. In other words it worked like a grid dipper. The aluminum shield between the two coils solved the problem and no further remedies were necessary throughout the entire tuning range of the front end.

A coax antenna connector is mounted on the last partition so that the antenna or the output of converters could be brought right up to the switch, thus avoiding long leads. A short piece of coax is connected to this input and soldered to the antenna input connector on the back of the main chassis as shown on the photo. This method of shielding the input eliminates possibility of picking up stray unwanted signals, which can become a problem with sensitive front-ends.

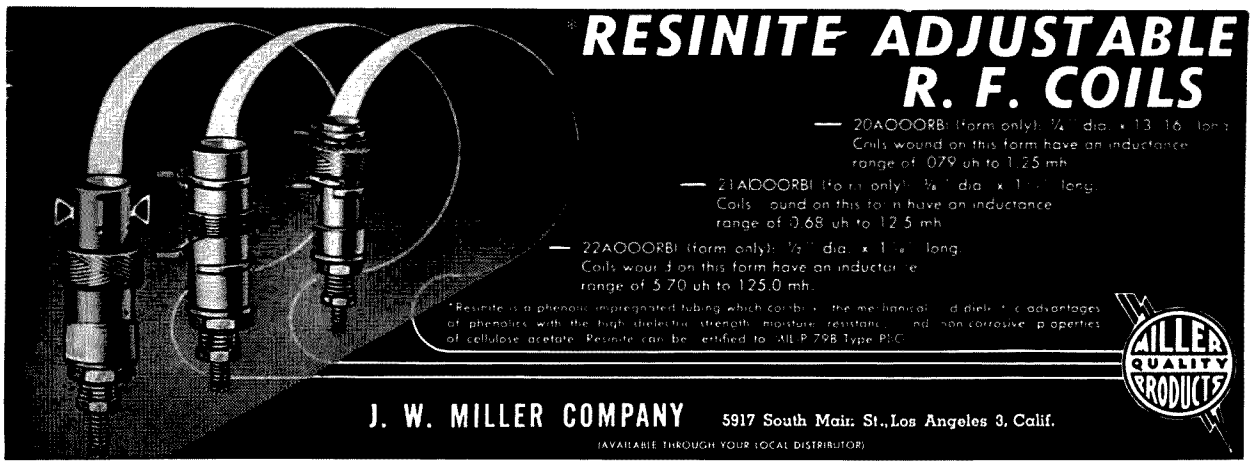
All rf coils are Miller high Q unshielded slug tuned coils listed in the parts list. Originally, the oscillator coils above the broadcast frequency were phenolic type but were rewound on the slug tuned ceramic coil forms that were on hand. Nothing has been gained in making the change since phenolic at frequency up to 30 mc is quite stable and does not warrant the trouble.



A slight modification of the broadcast oscillator coil was required since it was designed to be used with a lower *if* frequency. This was a simple matter of peeling 10 turns to get up to the higher *if* used in this unit.

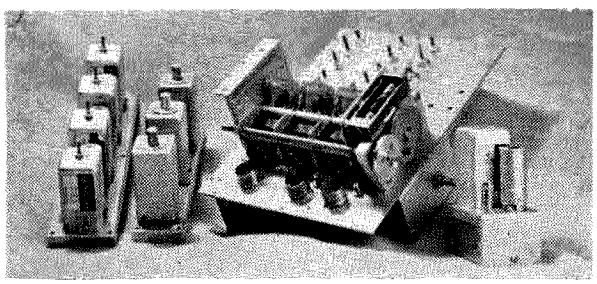
As noted on the coil list, band 4 uses the same type of coils as band 3, with only the oscillator coil modified by peeling off 3 turns. Of course the slugs in band three are set deeper into the coils to lower the frequency.

Notice on the frequency list that the broadcast frequency coverage is only 500 to 800 kc. This was done to simplify construction of the front end and to use only one tuning capacitor for all the bands. Since the main tuning capacitor had to be stripped down to the value listed, a range of 300 kc on the broadcast band was all that could be covered. Of course the frequency could be shifted up a little higher and a greater spread could be had, but the in-



terest was mainly on the distress frequency of 500 kc and the Conelrad frequency of 640 kc, letting the additional broadcast frequencies fall where they may since no attempt was made to cover the entire range.

The very important item of this rf module is the main tuning capacitor which was purchased in a surplus house for practically nothing. Having good bearings and good alignment of plates, it had to be modified by removing some plates, since the original capacities were 250 mmfd per section. It was also modified



Modules. Four of the completed modules.
The rf module showing the line up of tube sockets and the method of fastening of the added 6" brass shaft.

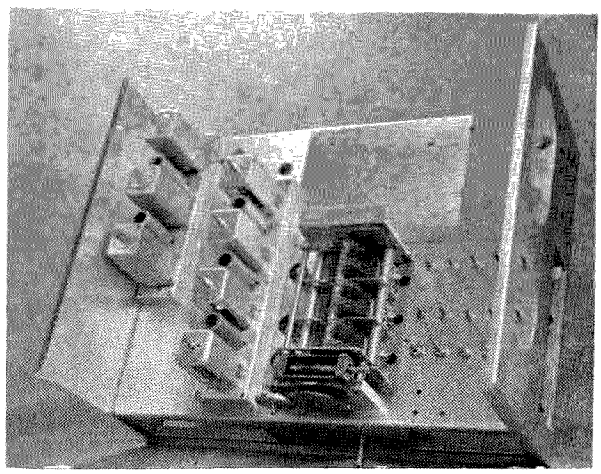
mechanically by altering the frame and adding a worm drive; a couple of drive gears with an additional shaft running parallel to the capacitor shaft so a large dial could be fastened to the front end of this shaft and motor limit switches could be provided at the back of this shaft. On the worm drive shaft a 4 inch aluminum disc was fastened, partly projecting through the front panel, to be used as vernier tuning. The top side of this knurled disc serves as a reduction drive for the motor. This can be seen on the photo. The 4" aluminum disc was made from ¼ inch flat stock and fastened to a hub turned out on a lathe.

A small dc reversable motor fastened to a rigid bracket drives the 4" disc by friction through a ⅜" rubber covered pulley on the motor. A detailed illustration of this assembly would be superfluous, since those interested in copying this design will have their own ideas for fabricating and assembling of similar parts.

The perforated box seen in the picture is a cover under which is housed the 25 volt dc supply for the motor. This unit is assembled on a aluminum plate that serves as a chassis, and this in turn fastened to the main capacitor dust cover.

In altering the capacity in each of the three sections, a Tektronix-Type 130 L, C, meter was used which simplified the work and produced accurate results. However, since a meter like that is seldom found in a ham shack, an alternate method reasonably accurate could be done in the following manner.

In purchasing a tuning capacitor the max. and min. capacity is generally specified. With this knowledge on hand, count the number of rotor and stator plates, then divide the total section max. capacity by the total number of plates. This gives you the mmfd per plate. Knowing this, its just a matter of removing the rotor plates (these are easier) to get the desired max. capacity in each section. The max. capacity in the oscillator section should be between 95 and 100 mmfd and the max. capacity of the rf and antenna sections should be 125 to 130 mmfd. A word of caution! When buy-



Main Chassis showing rf module and the two if Modules in place.
Notice the modified tuning capacitor with the added worm drive and the 6" shaft with the hub to which the plexiglass dial will be secured. The far end of this shaft has the cam to operate the limit switches for drive motor. The shaft extending below the capacitor belongs to the band switch.

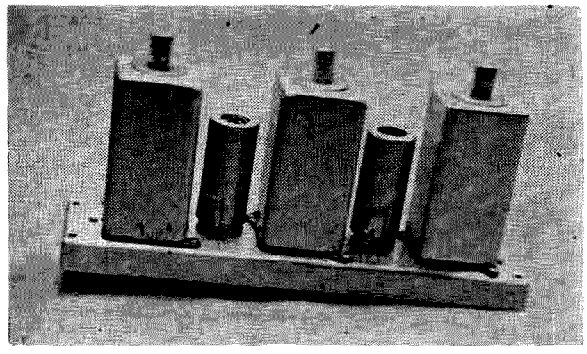
ing capacitors of this type, be sure that the unit is ruggedly built with good front and back bearings and good alignment of plates. Otherwise, you might experience frequency shift, instability and microphonics, so common in bargain variables.

RF Circuit

Now that the front-end mechanics are out of the way lets take a peek at the circuit. The three tubes are parallel to the capacitor and are placed within 1" on center from the frame. The first tube nearest the front panel is a 6C4 hf oscillator, next is the 6BE6 mixer and the farthest one is the 6AK5 rf amplifier that replaced the original 6BA6 because of better performance. Shown on the schematic are the jumpers in the switch wafers from band 4 to band 6; this is done so that in position 6 the receiver is used as a *if* strip for the xtal converters that feed into band 4 antenna circuit through the .001 capacitor, but the antenna itself is grounded. A slight shift in frequency was apparent due to the increase in inductance of the coils through these jumpers. Since the dial was hand calibrated on all bands, including the converter bands, that presented no difficulty.

The rf socket is wired so that tubes, such as 6AU6, 6AG5, 6BA6 and others can be used as replacements with slight loss of gain. This is accomplished by the usual method of tying the suppressor grid to the cathode, adding a little self bias by the 68 ohm fixed resistor and connecting this resistor with the 5K pot on the front panel used as the rf gain control. This cathode circuit is by-passed for low and high frequencies with .02 and .005 ceramic disc capacitors as shown.

The grid of this stage returns to the AVC bus, through the isolation resistors indicated on the schematic and is coupled to the tank circuit



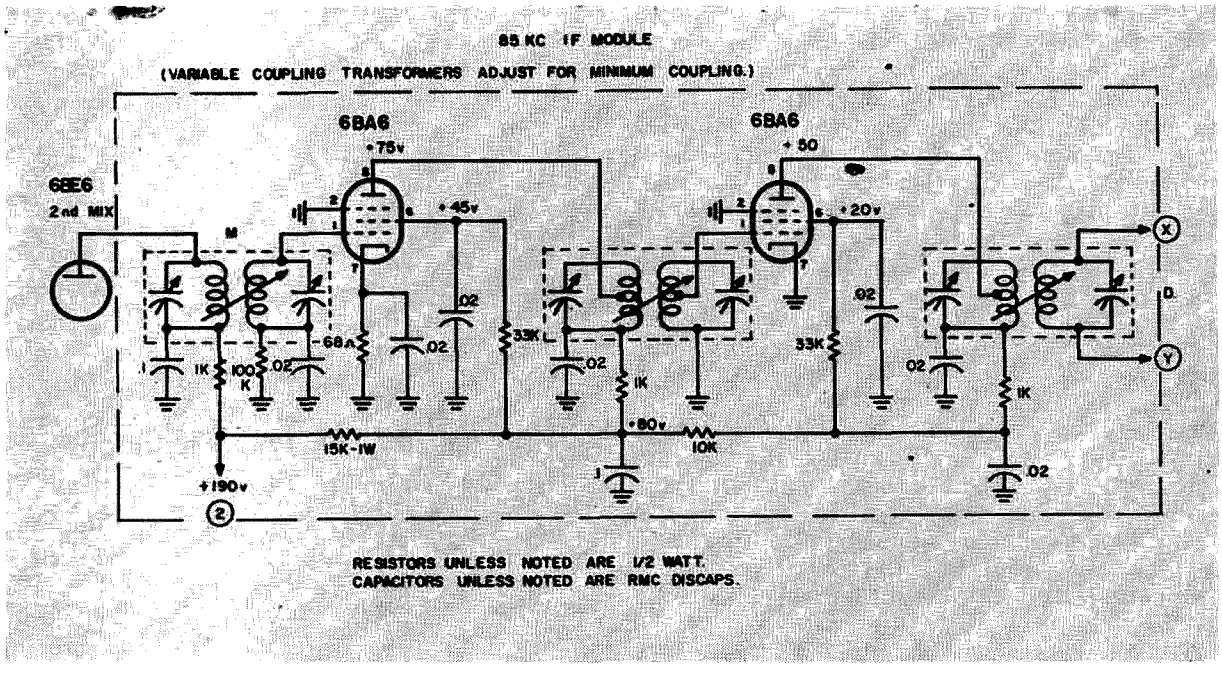
85 K C Module: Aluminum chassis is 1¾" x 8" x ½". Three 85 kc variable coupling transformers; coupling adjusting bakelite rod under the knurled caps in center of transformers.
Two 6BA6 pentode amplifiers.

through a 50 mmfd capacitor. From the stator of the main tuning capacitor (antenna section) a lead is brought out to the 50 mmfd trimmer on the front panel that is used as the antenna trimmer.

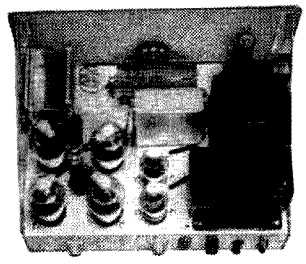
The plate of the amplifier returns to the arm of the ceramic band switch and the cold bypassed end of all rf coils tie together and connect through the 5 ma S meter to B+ as shown on the schematic.

The meter has a 100 ohm pot for zero adjustment and this is placed on the front panel just below the S meter. This arrangement provides flexibility in signal strength readings, since the meter can be set for zero noise reference, when giving reports.

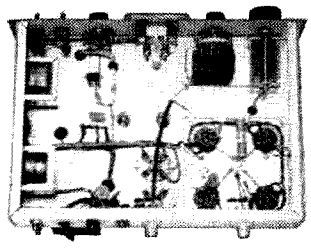
The final mixer stage is the common variety of 6BE6 pentagrid converter, using separate injection as shown on the rf schematic. Coupling capacitor which is a 14 mmfd NPO is used to bring the signal from the high frequency variable oscillator to the mixer. This coupling capacitor can be varied slightly, however, this



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value proved to be optimum in this arrangement of band switching. Oscillator injection is varied to a large degree in an arrangement where band switching is used due to the varied output of the oscillators, so a compromise must be made by selecting the proper coupling capacitor to tie the injection voltage in the proximity of 10 volts on all the bands.

Higher injection, by using larger capacitors, will increase the signal strength slightly, but will also bring in a lot more noise. Lower injection voltage will decrease the over all sensitivity of the front end.

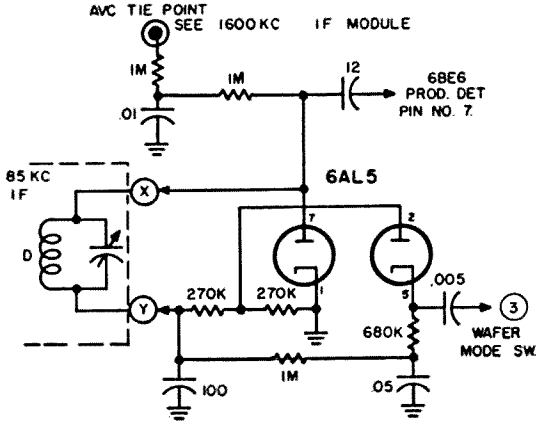
The plate of the mixer ties into the 1600 kc *if* transformer as shown.

Oscillator tube is a 6C4, connected in a Hartley circuit and drift compensated with a 2 mmfd N750 ceramic capacitor and the 47 mmfd N1500 grid blocking capacitor, as shown on the schematic. A 2 mmfd NPO, in series with a 10 mmfd variable capacitor, is soldered to the cathode of this tube and is used as fine tuning in the SSB or CW position. Front panel engraved as "Osc Cal.". The plate of this 6C4 returns to the OA2, 150 volt regulator tube.

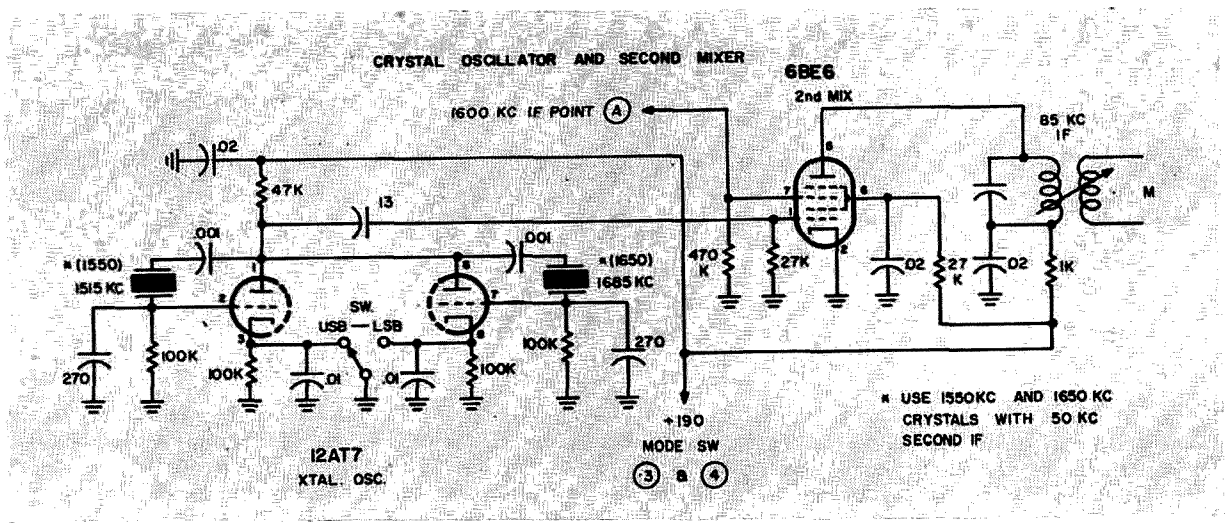
Second *if*

With two modules out of the way, the low frequency *if* strip was next on the agenda. This unit is similar to the 1600 kc *if* but the fabricated chassis measures 1¾" x 8" x ½", for which a cut-out in the main chassis was made ½" smaller all around. The three 85 kc transformers used in this module have means of adjusting the coupling by a bakelite rod located in the center of the transformer. Coupling from "critical" to "overcouple" can be varied by this rod which separates the primary coil from the secondary. Those of you that have these transformers for this project, adjust the transformers by separating the coils out as far as they will go, and then peak the air trimmers to the center frequency. You will notice a slight loss of gain, but you will sharpen the response to the point of separating most signals in the crowded bands.

Alternate way of building this module is to use 50 kc Miller transformers 1898-AX which have a band pass of 1500 cycles making it a very selective *if* strip.



LOW FREQ. (85 KC) DETECTOR, ANL AVC

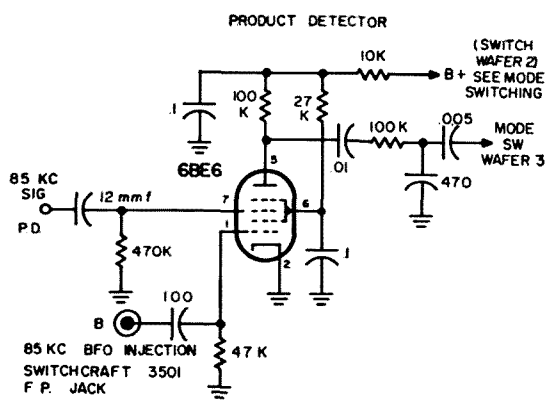


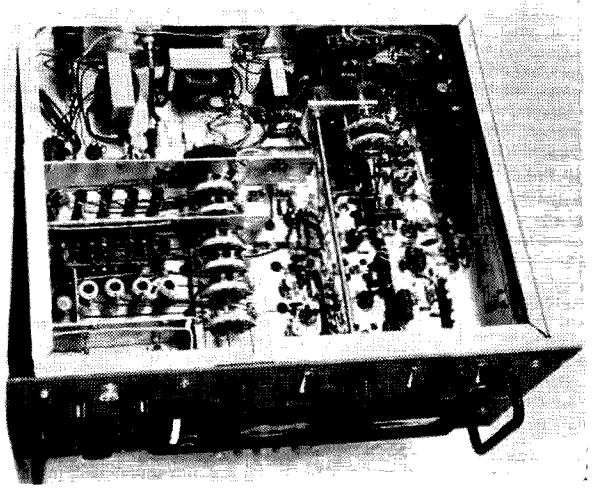
The circuit, as per schematic, is quite standard and no mention of small components are necessary since they are all listed in the parts list or shown on the drawings.

The second mixer is also a 6BE6 pentagrid converter tube with separate injection oscillators consisting of a 12AT7 wired as dual xtal oscillators, using crystals of 1515 and 1685 kc. The oscillators can be turned on by grounding the cathode of each triode through a single pole double throw toggle switch placed on the front panel and engraved USB or LSB. Either oscillator is used in the sharp AM position but in SSB, upper or lower side band can be selected. This oscillator is only active when the mode switch is in sharp AM or SSB position.

The AM detectors, as indicated in the schematic, are 6AL5 which serve as detectors, automatic noise limiters, and AVC generators.

The FM discriminator is the old stand-by Foster Seeley and AVC voltage is taken at the junction of the two 100 K resistors and fed through a 4.7 meg resistor to a junction terminal of the AVC bus. At this point it is filtered by the .05 capacitor and fed to the stages requiring AVC control. The product detector is a 6BE6 converter tube with separate injection oscillator which is the 6C4 BFO module. The injection is to grid pin No. 1 of the 6BE6 through a 100 mmfd capacitor. The 85 kc signal is fed into signal grid pin 7 of this tube. The signal output is at pin 5 through the RC network, which connects into the mode switch.

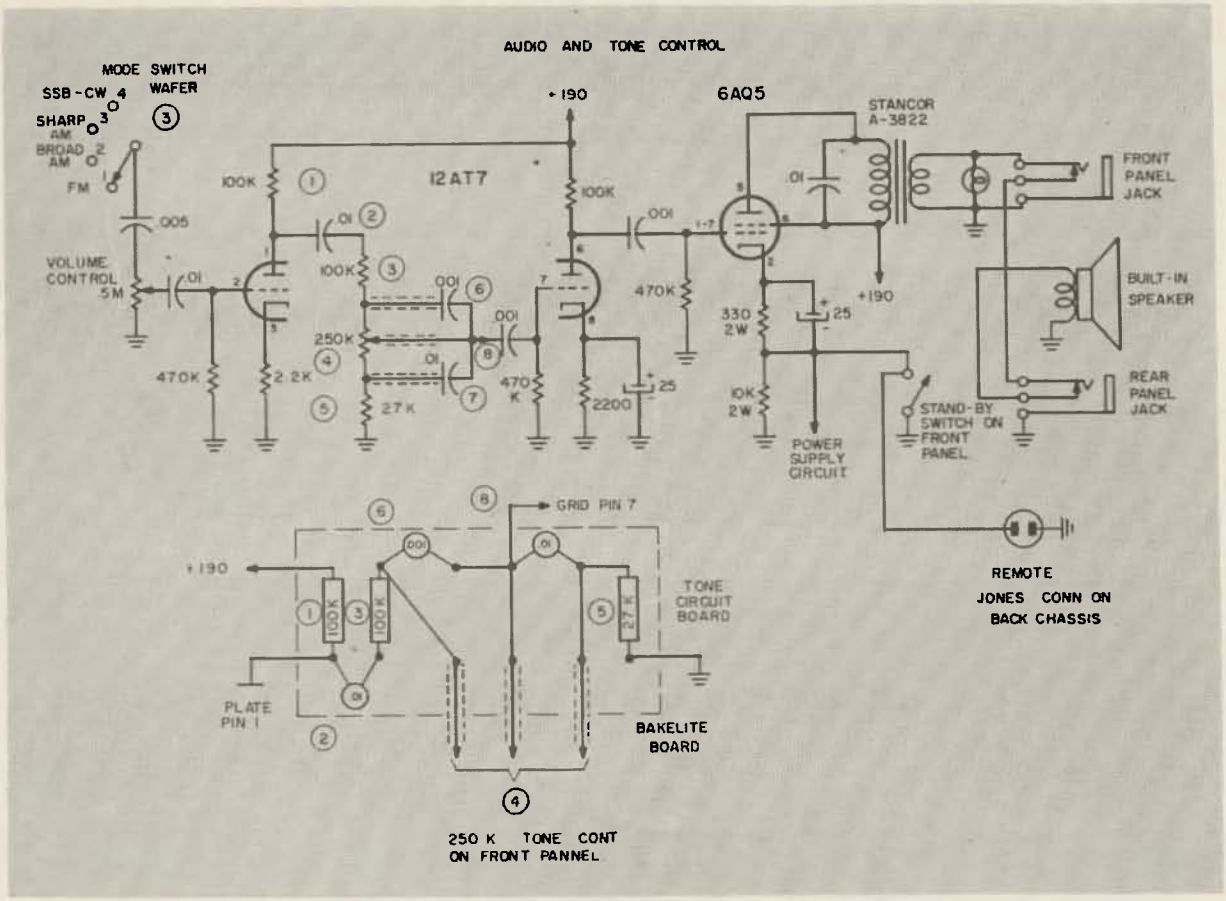




Bottom View showing the ceramic band switch and the aluminum partitions for shielding of the rf coils. Shown also is the gear driven mode switch and just below the gears mounted on the back of the chassis is the "tone module." The coax antenna cable and connector is also shown running to the rf partition. Before the final adjustment of the rf coils, the bottom plate 13 x 17" made of aluminum is secured for good shielding.

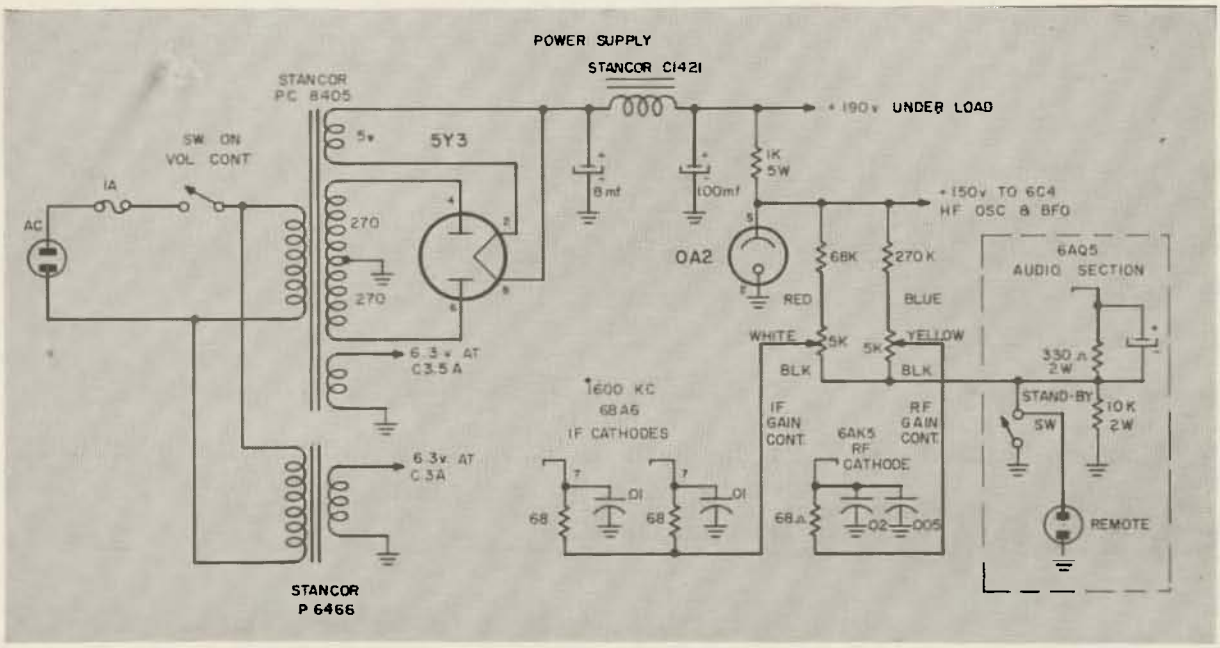
The audio section is a 12AT7 voltage amplifier and a 6AQ5 as a power amplifier which drives a Stancor A-3822 output transformer. The secondary of this transformer is shunted with a No. 44 pilot lamp to protect the voice coil on the 4" built-in speaker. This speaker is disabled by inserting a phone plug into either the front panel jack or the rear jack when using a larger speaker or low impedance phones.

The mode switch located at the far end from the front panel is a ceramic two wafer 2 pole, 6 position per wafer Centralab switch No. 2011 with the stop set for 4 positions. This switch is mounted on a bracket fastened to the main chassis and is gear driven for the purpose of



locating this switch right at the detectors. Shielded wires are unnecessary because of the very short leads to this switch. The switching of operational mode is accomplished by selecting the detectors and at the same time feeding B+ to the desired part of the circuit as shown in the schematic.

Main power supply is of a full wave design, using a 5Y3 rectifier and a PC8405 Stancor power transformer, with a Stancor C1421 filter choke. An 8 mfd input capacitor and a 100 mfd filter capacitor at the output makes a hum free power source. Since a large number of tubes are used in this receiver, the heater supply was insufficient in the power transformer alone, so an additional filament transformer had to be used and the heaters currents so divided that neither transformer was overloaded. The filament transformer is a Stancor P6466 a 3 amp job. Voltage regulator which is a OA2,



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1 watt 20% 6.2v	1.35
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100ma 1500piv hi-V silicon	2.25
100ma 2000piv hi-V silicon	2.95
100ma 3000piv hi-V silicon	4.45
500ma 200piv epoxy, sim. 1N2069	.30
500ma 400piv epoxy, sim. 1N2070	.40
500ma 600piv epoxy, sim. 1N2071	.70
750ma 50piv replaces 1N599	.11
750ma 100piv replaces 1N600	.20
750ma 200piv replaces 1N602	.33
750ma 300piv replaces 1N603	.39
750ma 400piv replaces 1N604	.48
750ma 500piv replaces 1N605	.60
750ma 600piv replaces 1N606	.75
750ma 700piv —	.95
750ma 800piv —	1.25
750ma 900piv —	1.50
750ma 1000piv —	1.95
750ma 1500piv —	3.25
750ma 2000piv —	4.15
2amp 50piv replaces 1N2026	.17
2amp 100piv replaces 1N347	.30
2amp 200piv replaces 1N2027	.45
2amp 400piv replaces 1N2029	.90
2amp 600piv replaces 1N2031	1.35
2amp 800piv replaces 1N1236	1.75
2amp 1000piv replaces 1N3366	2.90
2amp 1500piv replaces 1N3371	4.70
2amp 2000piv —	6.50
2amp Cont. Rect. similar 2N1600	3.50

RECTIFIERS

2amp 50piv axial lead	$0.15
2amp 100piv axial lead	.27
2amp 200piv axial lead	.40
2amp 400piv axial lead	.85
2amp 600piv axial lead	1.20
2amp 800piv axial lead	1.60
2amp 1000piv axial lead	2.80
2amp 1500piv axial lead	4.30
2amp 2000piv axial lead	6.00
12amp 50piv replaces 1N1199	.75
12amp 100piv replaces 1N1200	1.20
12amp 200piv replaces 1N1202	1.75
12amp 400piv replaces 1N1204	2.60
12amp 600piv replaces 1N1206	3.75
12amp 800piv —	6.90
12amp 1000piv —	9.50
20amp to 400 piv. Cont. Rect.	14.00
25amp 50piv replaces 1N248A	1.50
25amp 100piv replaces 1N249A	2.50
25amp 200piv replaces 1N250A	3.70
25amp 400piv replaces 1N2136A	4.75
25amp 600piv replaces 1N2138A	7.75
25amp 800piv —	10.00
50amp 25piv —	2.70
50amp 50piv similar 1N411B	3.98
50amp 100piv similar 1N412B	5.98
50amp 200piv similar 1N413B	6.50
50amp 400piv —	9.75
50amp 600piv —	16.00

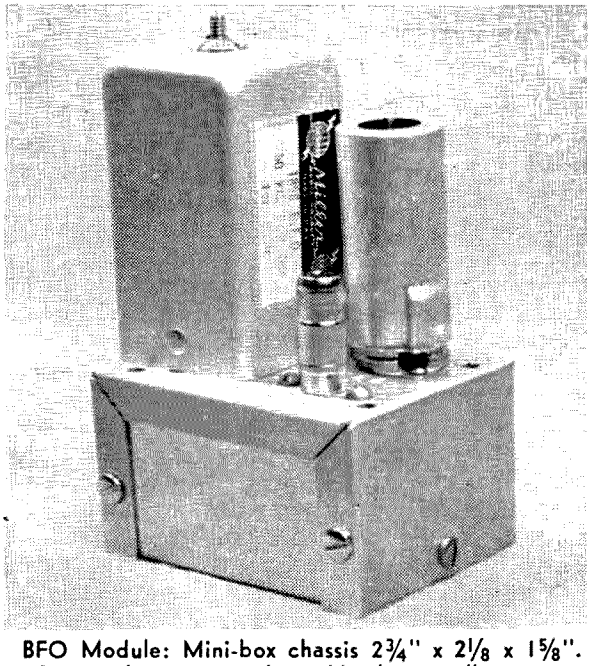
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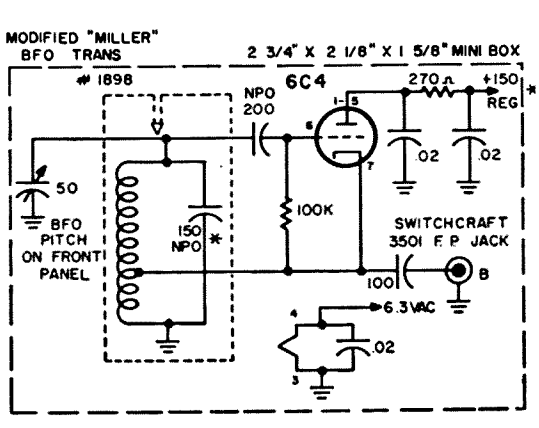
150 volt regulator tube supplies power to the VHF tuning oscillator, the BFO oscillator and the bias for rf and *if* gain control as seen in the schematic. DC motor power supply is a half wave selenium rectifier type, using a Stancor P6469 25 volt at 1. amp transformer and a 500 ma rectifier.



BFO Module: Mini-box chassis 2¾" x 2⅛ x 1⅝". 6C4 triode connected as Hartley oscillator using modified Miller 1898 BFO transformer. Cathode output through switch-craft Jack 3501 F P and plug 3502.

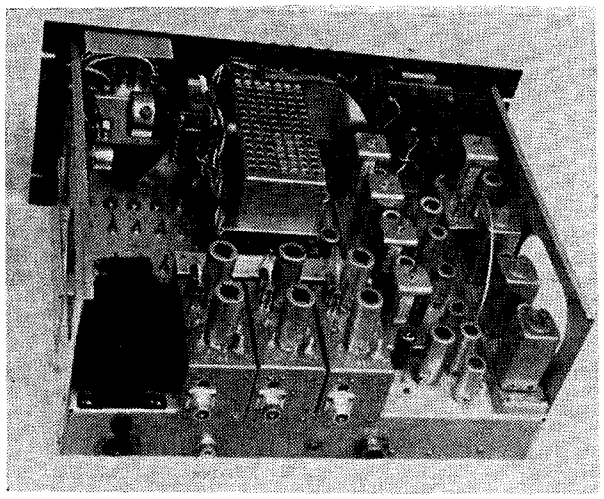
Dial

One of the most difficult items to make is a commercial looking dial. If you ever tried to duplicate a snappy looking dial for your receiver, VFO or what have you, you have probably made several of them before you obtained satisfaction; at least this was the case of this dial. Several attempts were made before a satisfactory dial was assembled without the use

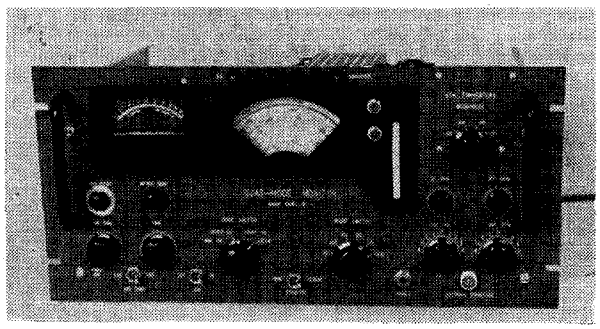


NOTE: REPLACE ORIGINAL TUNING CAPACITOR IN THE TRANSFORMER WITH NPO 150mmf * TO TUNE TO 85 KC.

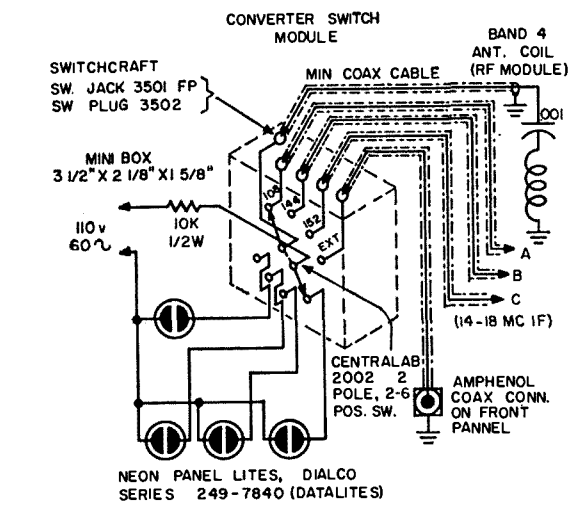
* POS 4 ON 4th WAFER. SEE MODE SWITCHING.



Back View showing the xtal converters, 25 volt DC power supply, and the small drive motor. To the left of the motor is the speaker with the pilot bulb overload protection. In back of the motor is the converter switch module showing the switch-craft plugs. To the right of the converters is the audio amplifier and the four detectors. In front of the detectors is the second mixer and the crystal oscillators.



Front View, showing all controls and engraved nomenclature for ease of operating. The two buttons to the right of the calibrated dial are the push button motor switches. Just to the right of these switches is the knurled disc for vernier tuning. When the picture was taken, the plexiglass window with a black hair line for the dail was removed to eliminate reflections.



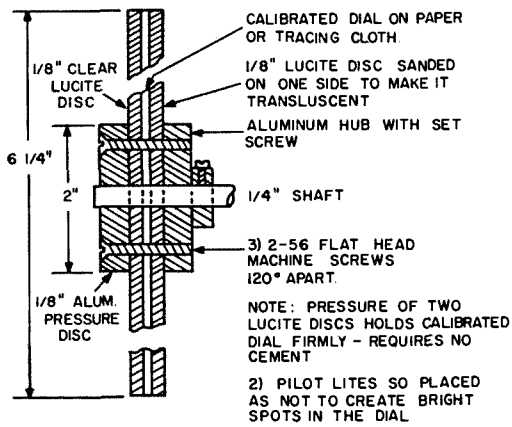
NOTE
A = 108 MC CONVERTER.
B = 144 MC CONVERTER.
C = 152 MC CONVERTER.

of cement. A cross sectional detail is shown how this was accomplished with great success. The dial scale was drawn with India ink on a piece of transparent tracing cloth. Then two 6¼" discs of ⅛" plexiglass were cut out with a fly-cutter. Placing the cloth scale between the two plexiglass disc and securing them in place, as shown on the detail, makes a blemish proof dial comparable to the silk screen dials used on commercial equipment.

Converters

Looking at the back of this receiver you will notice the three identical boxes to the right of the power transformer. These are the bantam converters previously described in Oct. 1960 issue of 73. Slight mechanical modifications were necessary to enable them to fit into this design but the good circuit was left alone. In modifying the units the mini boxes which are Bud CU-3003A, 4" x 2¼" x 2¼" are used so that the adjustable ceramic antenna coupling capacitor can be placed above the coax antenna connector for easier access to peaking.

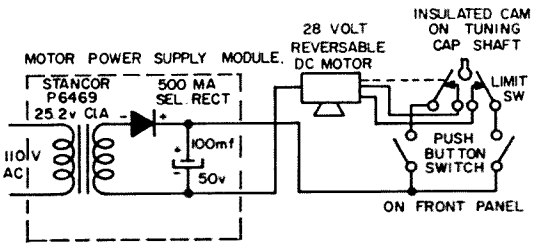
CROSS SECTION DETAIL OF DIAL CONSTRUCTION



Previously this capacitor was trimmed from the side of the mini box and had to be adjusted before securing the converter in place. The *if* output connector was also changed to switchcraft 3501 FP and placed on top of the converter. This connector is much smaller and lends itself for better arrangement. All coil forms used in these converters are J. W. Miller ceramic foil forms No. 4400 because of smoother peaking action and rugged construction.

Converter plug-in assembly is made up of two L shaped pieces of aluminum 7" long by 2¼" high by 1⅛" wide which are arranged into a rectangular tunnel to house the power wires and the coax cables. These L pieces are held together by spacers and only one L is secured to the main chassis by 4-40 screws. The other L piece which is held by the spacers has the cut-outs for the three Jones connectors S-303-AB and the three ¼" holes for the miniature coax *if* cables seen in the picture. The S-303-AB connectors are fastened by binding head 4-40 machine screws which are placed in

25 VOLT POWER SUPPLY AND MOTOR SWITCHING



oversize holes to permit good alignment of converters.

In conclusion may I say that in the past few months I have received a number of letters and post cards voicing constructive criticism from those that are duplicating the "Tri-Mode Monitor" described in Nov. 1960 issue of this magazine. Most of the mail stated that pertinent details and photos were not included in the manuscript thereby making construction of that project more difficult. So to comply with these requests, I sincerely hope that those of you who will attempt this project find in this manuscript sufficient material to go ahead without delay—Good luck!

To Frank Lodi my thanks for the use of his camera.

To Howard Trieb K9EPB my thanks for his part in processing the pictures. . . . W9DUT

J. W. Miller coils

	ANT.	RF	OSC.
BAND 1	A-5495	A-5495 RF	A-5496-C remove 10 turns
BAND 2	B-5495-A	B-5495 RF	B-5496-C
BAND 3	C-5495-A	C-5495 RF	C-5496-C
BAND 4	Same as band 3 but remove 3T from osc coil only.		
BAND 5	D-5495-A	D-5495 RF	D-5496-C
BAND 6	converters		

2—1600 KC IF J. W. Miller 913-WI Transformer
1—1600 KC LIM. J. W. Miller 913-WI Transformer
1—1600 KC DISC J. W. Miller 913-WD Transformer

Alternate

If 85 KC if transformers are not available
3—50 KC IF J. W. Miller 1898-AX transformers. Use xtals of 1550 KC and 1650 for second conversion
1—BFO TRANS. J. W. Miller 1898-BFO
3—CONVERTERS
18—COIL FORMS J. W. Miller No. 4400 ceremic 3/8" x 1 1/16"
see Oct. 1960 **73 Magazine** for details

Note

All resistors unless otherwise noted are ½ watt.
All ceremic disc capacitors are "RMC discaps."

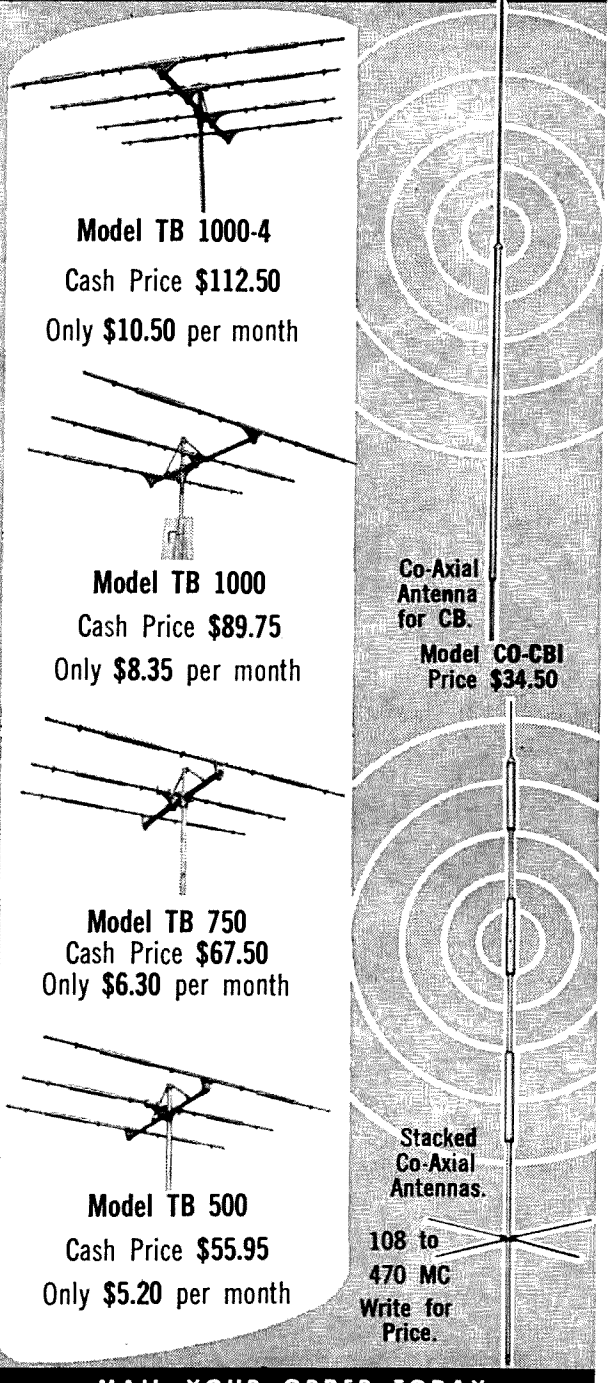
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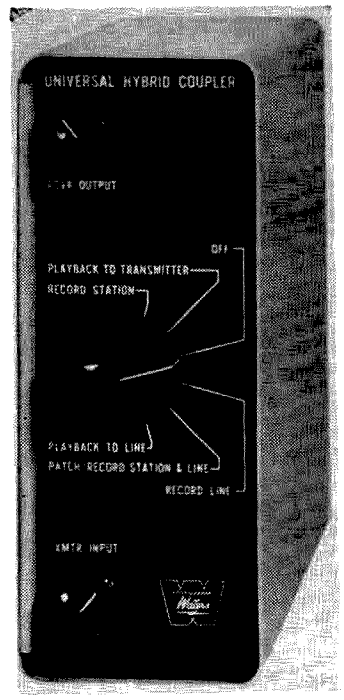
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146 Hillcrest Avenue
Morristown, New Jersey

73 Tests The Waters Universal Hybrid Coupler



A Break-through in Operating Versatility

NOW here is something really NEW in phone patches and the gang will want to know about it. If the Waters Universal Hybrid Coupler were nothing more than a cracking good fone patch (which it is) it is competitively priced at $49.50 net. As fone patches go, it's about as near a "set-and-forget" item as we've tried—including some pretty fancy and some home-spun versions. But this neat little gadget in providing facility for connecting in your tape recorder, affords a range of operating and experimental capability not heretofore available.

Regardless of your operating interests, phone or CW, traffic handler or experimenter, DXer or plain rag-chewer, you are likely to find the record and playback feature fulfilling a need few of us have realized could be satisfied so conveniently. Let's take a case we've all encountered for example—"Look OM, I hate to tell you because I can't describe it, but there's something wrong with your signal there and I think you'll want to have a look around and see if you can run down the trouble." So you bat around a while trying to find out what is meant—maybe make a few checks with other stations—and end up with so many confusing versions and pot-shot guesses that soon you are staring out into space confused and contemplating taking up stamp collecting. Not now, you don't—with the Hybrid Coupler and tape recorder. You switch the Coupler to RECORD STATION, put the transmitter on the dummy antenna, crank down the gain of the receiver, and record your signals right there in your own station! Now *you* know what the gang "couldn't describe" to you and you can check and make adjustments until you *know* the signal is a good one.

The experimenter will use the record-playback feature like he uses his oscilloscope—in fact, as a supplement thereto— for checking out his audio, a new filter, modulation capability, linearity adjustments, compressor characteristics and a host of other things. It's well enough and necessary to see on the scope what the signal *looks* like, but what else than the Universal Hybrid coupler and the tape recorder to tell you what it *sounds* like? After all, it's what the receiving operator hears that counts. And another thing—if the receiving operator asks you to tell him what *he* sounds like you just switch the Coupler to PLAYBACK TO XMTR and shoot his stuff right back to him. If you do satellite tracking like we do here at K2CM, you glamorize the gang with the signals from OSCAR (or some other bird) as received on the latest pass! For satellite

tracking, gentlemen, recording is the *only* way. You've got all your data canned immediately and available for call-out at any time.

I'm not what you call a traffic man and maybe you aren't either but we all like to do a favor. Like when I get "Say Mac, when you talk to W9XYZ tonight will you tell him his XYL will be on Flite 513 arriving Chicago O'Hare Airport at 2:20 tomorrow afternoon and he's to meet her and bring the dog along." Gosh, I used to have scraps of paper all over the place, but not now. I just say "Hold it Fred—now give me that again" and meanwhile I've switched my Coupler to RECORD STATION, flipped on the recorder, and I got

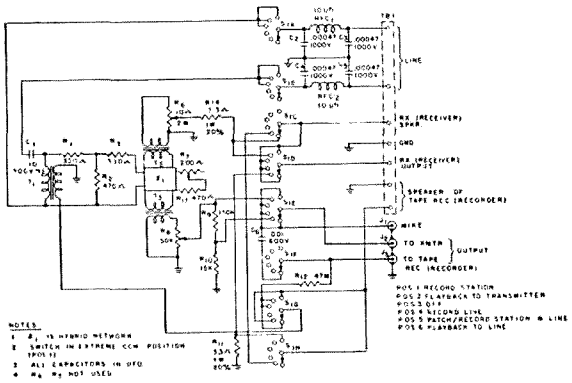


FIG 1 SCHEMATIC
WATERS UNIVERSAL HYBRID
COUPLER—MODEL 3001

it. When W9XYZ comes on I say "Hey Joe, I got some word on your XYL" and I spill the tape when I switch the Coupler to PLAYBACK TO XMTR. Easy, eh. Real traffic men will need no priming. They'll accept messages by telephone by recording direct from the line and "store" them till net time. They will save net time by recording incoming radio traffic for "copy" later after the net is closed. The Coupler provides this facility.

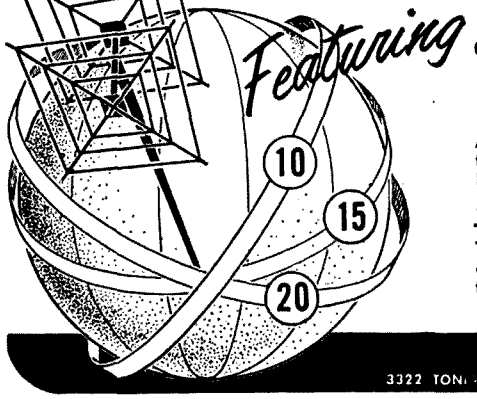
DXers can exchange information on that "rare one" by recording as they work him and playing back the signal characteristics to pals they want to cut in on how to find him.

Since you're working with voice or CW, a very ordinary "monaural" recorder does the job very nicely. No need to swipe the family hi-fi stereo job from Junior or the XYL, though it will do just dandy, if you can get away with it. The point here is that many hi-fi buffs are replacing the older recorders with the new snazzy jobs and the second-hand jobs are found in the want-ads of your local paper and can be picked up quite reasonably.

Whether you foot-switch from REC to SEND, use push-to-talk or work voice-operate or use CW, AM or SSB makes little difference in applying the Universal Hybrid Coupler to your station. This is all covered in the manual that comes with the device. And the package is designed with thought of affording convenience in locating the Coupler in your operating position. If vertical mounting fits better than horizontal in your layout, you simply remove the front panel and reverse it and the panel designations are reading the right way. Clever, ain't it?

The front panel carries only the six-position function switch and the output and input gain controls. These gain controls accommodate your leaving the transmitter and receiver controls in their normal positions so you don't have to fuss with things when you switch in the Coupler—and this is nice. With the function switch at RECORD STATION your radio equipment operates normally and the recorder takes both sides of your QSO. At PLAYBACK TO TRANSMITTER, what's on the tape goes out on the air and your receiver speaker is automatically connected to monitor the stuff outgoing. In the OFF position, telephone line is absolutely clear and disconnected and your station functions as normally. At RECORD LINE your station is still as used normally but the tape recorder is bridged on the telephone line available to take down an incoming

The CUBEX MK III De Luxe 3 BAND QUAD



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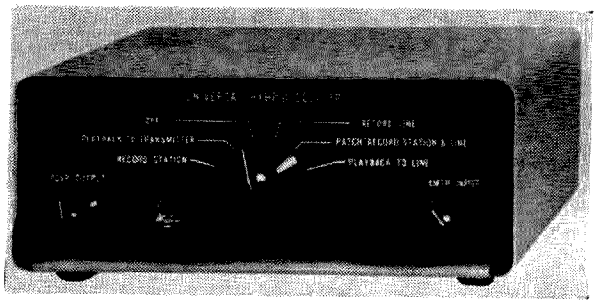
All models use the heavy duty Cubex support structure — 2" O.D. tubular alum. boom — Heat treated alum. spiders — Hi-Gain — Hi-FBR — Single feedline optional.

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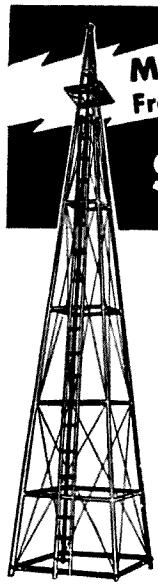


message from the "twisted pair." In the PATCH/RECORD STATION & LINE you are in the fone patch position and can or not, as you choose, record all that goes on, yourself on your own telephone instrument, the distant party on the wire, and the party at the distant radio terminal with whom you are in contact. Your receiver speaker and microphone are inactive—you handle the whole business on the telephone. Messages received via radio and recorded may be delivered by telephone by switching to PLAYBACK TO LINE. In either this or the RECORD LINE position your station is not involved and may therefore either be shut down or on the air.

All connections to the Coupler are made to the back of the instrument thus keeping the front panel clean. The "set-and-forget" NULL BALANCE control is also on the back. The Universal Hybrid Coupler provides such an unusually ample margin of balance that it may be adjusted on either a local or toll call connection that, once set, it just doesn't need to be touched again. All circuit elements of the Coupler are inactive, there is nothing to deteriorate, and a high degree of stability and reliability is thus afforded.

The circuit is shown in Fig. 1. The telephone line enters the Coupler through an rf filter to choke and by-pass any signal your telephone line may pick up from your antenna. A T-pad isolates the hybrid network, Z_1, and affords ease and stability of balance adjustment. Eight decks of switchpoints arrange the circuitry for the function selected by the operator.

We're not given much to going overboard with predictions, but we'll hazard a guess that the Universal Hybrid Coupler is going to find its way into many a ham station—not only because it's a good fone patch, but because, phone patch or not, it provides so many other useful features which are handy to have and have not heretofore been so conveniently available. Here at K2CM we've found the thing grows in on you—like a grid dipper, or an oscilloscope—you get to wondering how you got along without it.



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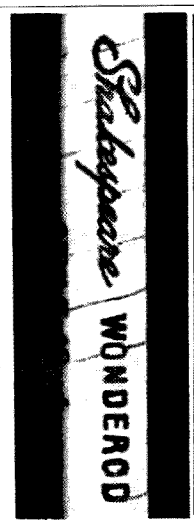
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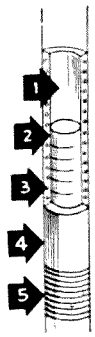
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	RANGE	STYLE
4 Ft. Antennas - $11.25	27 MC (CB)	73-0
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	35-42 MC	73-2
	42-50 MC	73-11
	10 Meters	73-3
	15 Meters	73-4
6' - $15.90	20 Meters	73-5
	40 Meters	73-6
	80 Meters	73-7
8' - $18.75	40 Meters	73-8
	80 Meters	73-9
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*Very Impressive Package

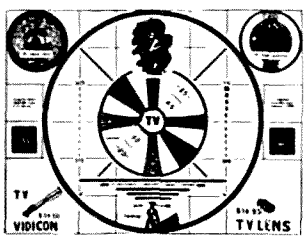
COLUMBIA PRODUCTS COMPANY
Shakespeare Co. Subsidiary, Columbia, S. C.

(W2NSD from page 4)

little VHF Amateur magazine. It is kind of sad to see it go—for the fellows that put it out worked hard for a long time to try and make it succeed in supporting itself. As I recall, the bulletin started back in 1957 or 8 as Channel A, a bulletin devoted to the doings of a small six meter net in northern new Jersey. Bob Brown K2ZSQ did a nice interesting job of it and fellows started requesting subscriptions from other areas. As the bulletin outgrew the little net the name was changed to QSO. Then as it grew further into an all-purpose VHF bulletin the name was again changed to VHF Amateur. Now all that remains of about five long hard years of work are a few yellowing back issues.

Older timers will perhaps remember back to the VHF News by Bill McNatt. This was a marvelous VHF bulletin and I treasure my back issues of it. This one was gobbled up by CQ back in 1952 or thereabouts. Bill sold out to CQ and ran the column in CQ for a few months before he gave up and quit completely.

Goodbye VHF Amateur.



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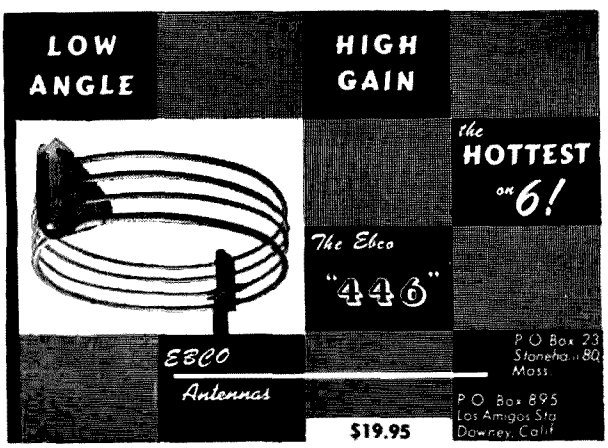
SEE PAGE 54

SEE YOUR DEALER

The Waters Universal Hybrid Coupler

(phone patch to you)

only $49.50 at all distributors



Radio Cairo

The Potomac Valley Radio Club has lodged a complaint against Radio Cairo for violating the international frequency agreement and operating on 7050 kc. This segment of the 40 meter band is allocated internationally to the amateurs and RC has no business there. It just might be helpful for clubs and interested amateurs to log reception of RC and send letters to RC, the International Telecommunications Union in Geneva, and the FCC. After the 1000th official complaint we might get some results.

Parts

National Radio Company has been busy adding to their rather wide line of parts. You might send for a catalog and let 'em know that hams still buy parts. You may be interested in their new line of low torque capacitors which are ball-bearinged to a fair-the-well (for working with small synchros) and should be great for an inertia dial. Then there are a couple of reduction mechanisms which reduce shaft rotation by 5:1 or 10:1, miniaturized and ball-bearinged. There are over 100 different models so you really have to have the catalog.

ATV Bulletin

The second issue of the Ham-TV bimonthly bulletin has just been published. This is a real interesting little (12 pages) paper which not only gives the latest operating news for TV hams, but also has some hot construction and conversion articles. Editor Shadbolt WØKYQ brings us three excellent articles this time, one by Jim Kennedy K6MIO on how to convert UHF converters to ham TV reception. This article covers the general conversion and goes into particulars on the Mallory Inductuner, the RME Model 200, and the G.E. UHF-103. Bruce Robinson VE90X has a fine article on the conversion of the surplus monitor receiver which was originally designed to accompany the famous ATJ/ATK iconoscope cameras. This monitor is the ID-66/AXR-1 (available from US #1 Electronics). Bruce also has a technical article on dc restoration. The ATV Bulletin costs just $1.00 per year

for six issues. Send a dollar to 73, Peterborough, N.H. and mark it for ATV, we'll sends issues 1 & 2.

OLD License Plates

Now that we have a huge hamsack to decorate it would nice to have some more unusual license plates to hang around. I'm particularly interested in getting call letter plates where the call letters are out-of-district calls. My meager collection now consists of a few W2NSD New Hampshire plates and a couple W6THN Tennessee plates. If anyone has any old plates like this to spare we would appreciate their sending 'tm on up to us.

Mountaintopping

One of my joys down through the years has been operating from the top of a mountain during VHF contests. There is nothing like a few thousand feet of height to bolster up one's score. I even have to admit that the availability of Pack Monadnock, one of the most popular New England VHF mountaintops, had more than a little to do with the selection of Peterborough as the first place to look for a new location for 73. The 73 HQ is exactly 3.5 miles down Route 101 from the Pack.

Now, after partially surviving the VHF Amateur magazine VHF contest, I can see that trying to operate a VHF station in the immediate vicinity of a popular mountaintop has its drawbacks. One of those non-crosstalk Telco converters would have been very beneficial. The Memorial High School Radio Club of Manchester took over the mountain and all we heard here for the weekend on six and two was Kay One Ugly Green Zombie, buoyed by seven inexhaustible youngsters.

I really can't grumble about it because they had the time of their lives and I'm all for such outings. This is one of the big benefits of the ARRL Field Day. But I can see where I have some mixed benefits on this mountain. What on earth will happen if the 73 clan moves up on the mountain for a contest at the same time as the Swamp clan with Sam Harris W1FZJ as their prophet? Can two kilowatt two meter stations with 64 element beams work side by side? Tune in on two and see.

Remember The Conelrad

The FCC, giving the arched bones a little kick, officially pronounced Conelrad dead on

(Turn to page 74)

HEY!

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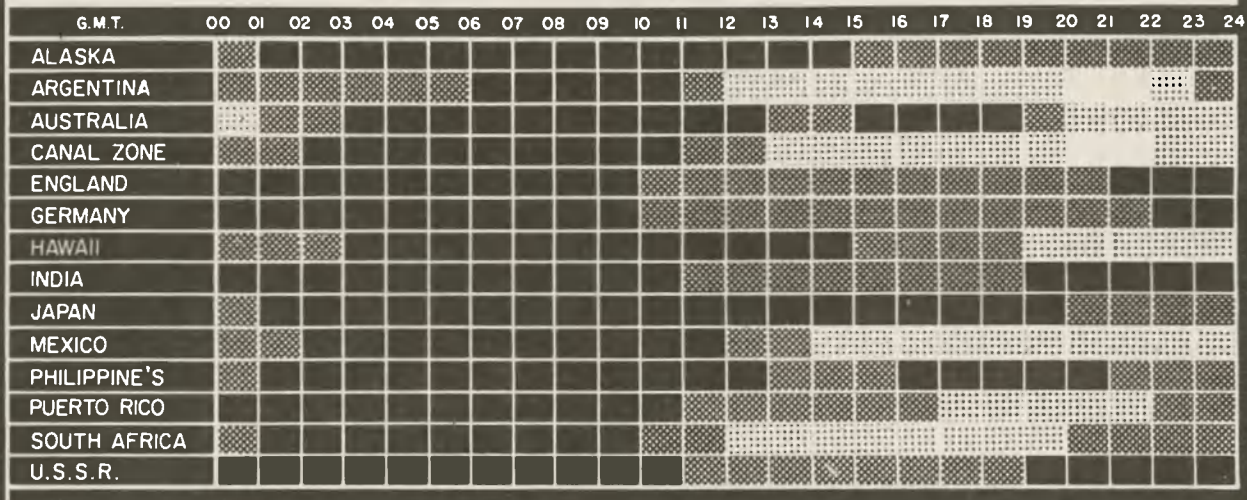
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RICHMOND HILL 18, NEW YORK

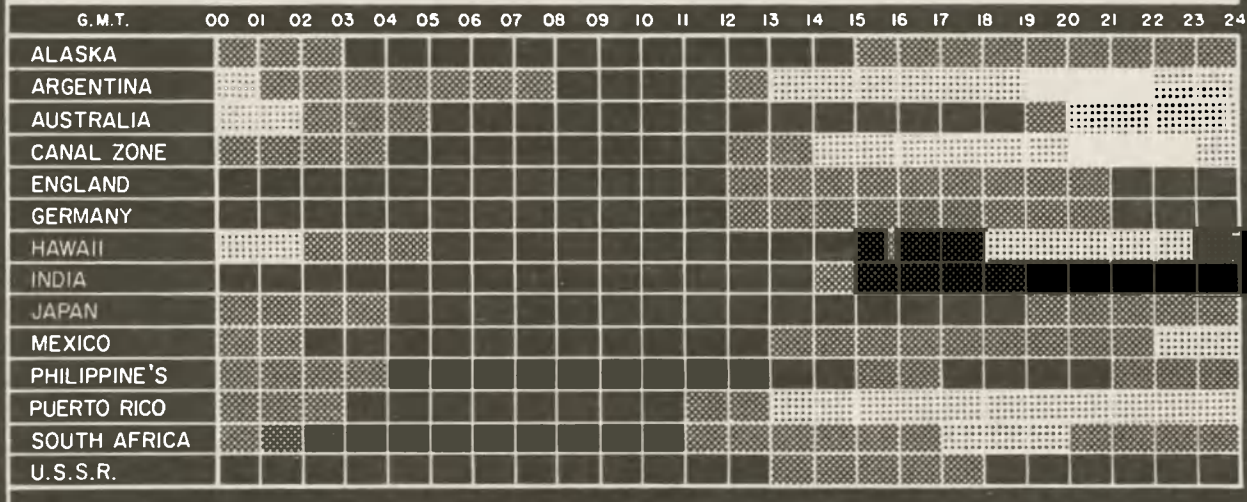
Phone: HIckory 1-7890

PROPAGATION CHART

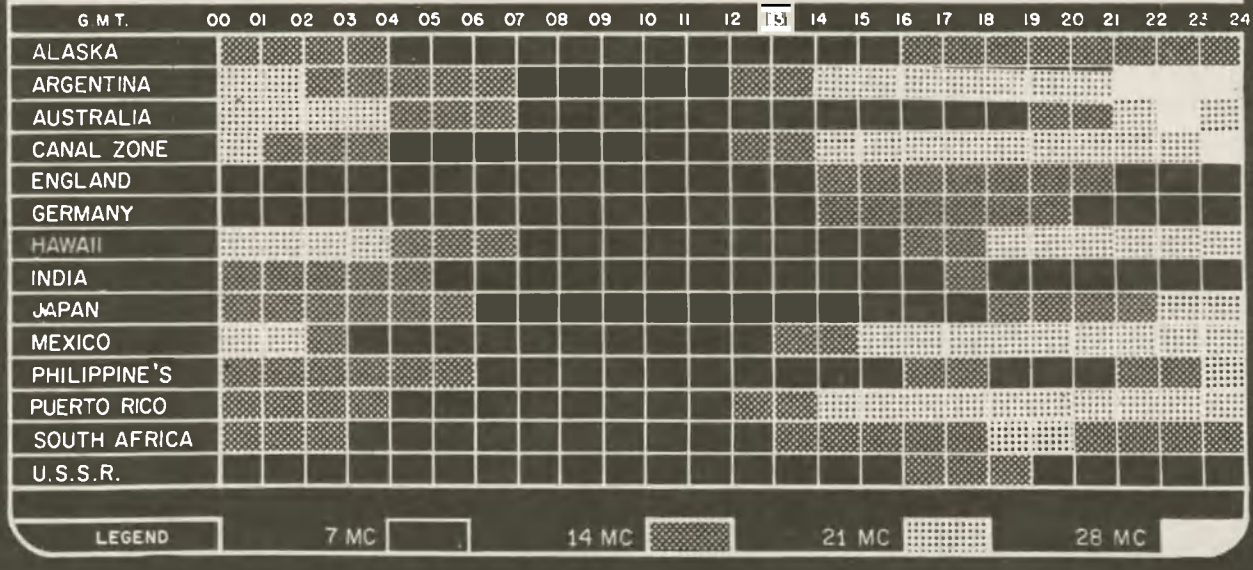
EASTERN UNITED STATES TO:



CENTRAL UNITED STATES TO:



WESTERN UNITED STATES TO:



Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

Advance Forecast: September 1962

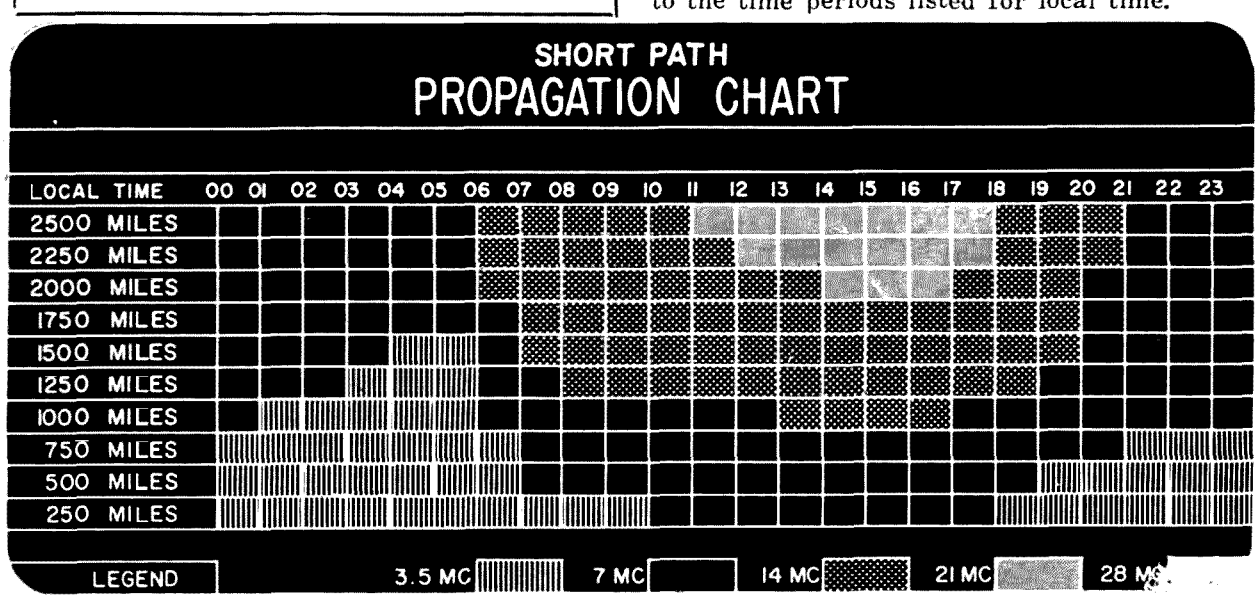
Good: 4-9, 14-26

Fair: 1-3, 10-13, 27-28

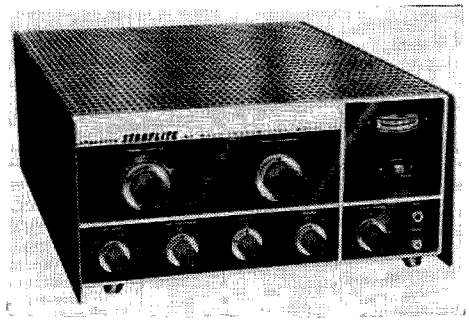
Bad: 29-30

Vacuum Variable, Jennings type 'U' 50 to 250MMFD. 15KV. $59.50
Isolation Transformer, 1200 Watts, UTC-R-76 .....$24.50
I-177 Manual, Tube Tester, TM-11-2627. $1.59
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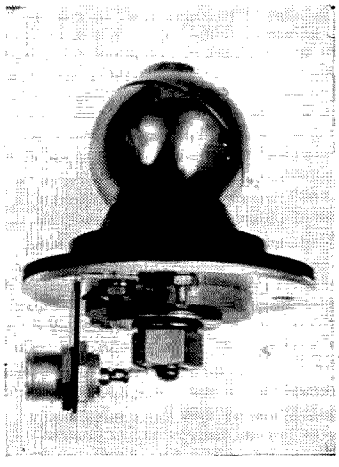
ALL BAND TRAP ANTENNA !
Reduces Interference and Noise on All Makes Short Wave Receivers. Makes World Wide Reception Stronger. Clearer on All Bands!
For ALL Amateur Transmitters. Guaranteed for 500 Watts Power for Pi-Net or Link Direct Feed, Light, Neat, Weatherproof
Complete as shown total length 102 ft. with 87 ft. of 72 ohm balanced feedline, Hi-impact molded resonant traps. (Wt. 3 oz. 1" x 5" long). You just tune to desired band for beamlike results. Excellent for ALL world-wide short-wave receivers and amateur transmitters. For NOVICE AND ALL CLASS AMATEURS! NO EXTRA TUNERS OR GADGETS NEEDED! Eliminates 5 separate antennas with excellent performance guaranteed. Use as Inverted V for all band power gain. NO HAYWIRE HOUSE APPEARANCE! EASY INSTALLATION!
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New Products



Lafayette has beaten the dollar-a-watt line with their new 90 watt CW input Starflite. Tunes 80 through 10 meters, holds fixe crystals (external VFO provision), controlled carrier modulation, grid-block keying, 6146 final. $82.75 in kit form. It even has a built-in low pass filter to keep the Indians down. If you send for information on this one tell 'em you saw it in Fortune and we'll drive 'em nuts trying to find it there. Lafayette, 111 Jericho, Syosset, N.Y.

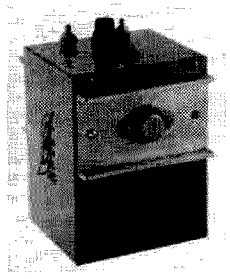


Hole in One

Webster Manufacturing, a brand new advertiser (page 31, write 'em), has a new mount which requires only one single $1\frac{1}{16}$" hole instead of the usual four holes. This is very handy since you can yank the amount when you get ready to pawn off that old wreck on some unsuspecting car dealer and fill the hole with the usual old broadcast whip.

Epsilon Records has just announced a new code record, ER1003. The 12" LP, which sells for $2.49, contains 46½ minutes of perfect code recorded at 15 WPM and presents a sketch of the life of Nikola Tesla in Morse Code. Played at 33⅓ rpm it comes out at 15 WPM; at 45 rmp you hear it at 20 WPM and at 78 rpm the code speed is 35 WPM. This record is an ideal way to increase code speed for it not only gives you perfect sending, but it gives you exact code speeds to measure your progress. See the Epsilon ad on page 67 of this issue and the piece on page 65 of the August 1961 issue.

Propagation Products, one of our more recent advertisers, piloted by W4EXQ, mentions that he is looking for tech manuals that may be laying around the shack. Bill wants surplus or commercial manuals on aircraft or electronics, including old ham equipment manuals and back dated ham magazines. Get a bid from Box 242, Jacksonville, Florida.



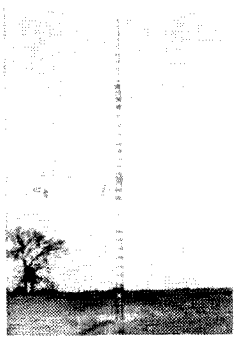
Quite a Handfull

Jim Morrissett brought one of the Topaz converters back with him when he reported for managing editor duty while I was off selling subscriptions in Europe. Somehow you don't really get the idea of the compactness of this unit until you are holding one in your hand. I've read the Topaz ads, of course, and even noted the dimensions they list, but still the actual converter was a surprise. 250 watts in that tiny package! (4" x 4½" x 6" approx.).

Topaz has models designed for most of the commercial transceivers and transmitters that you might consider using in your car. They particularly have specific models for the Swan Transceiver and the Collins KWM units. The outputs are available in the various units from 600 to 800 volts for the high voltage and around 300 volts for the medium voltage, plus a bias output. Even the turn-on relay is built into most models, sparing your transceiver the high currents involved and cutting down the heavy cabling.

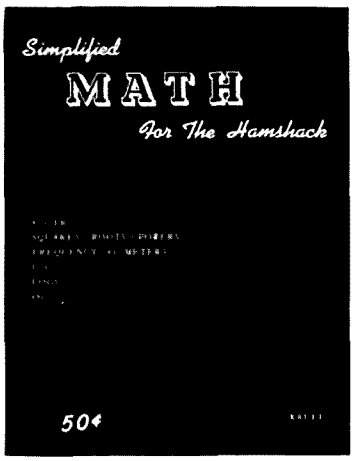
By keeping the power supply floating they have surmounted the usual problem of positive or negative grounding. Most of the models are for 12 volt systems, however, they have just recently come out with the first commer-

cially available transistorized supply giving 250 watts of output with 6 volts input. This provides me with an answer to the chaps who write in with a tear in their voice, wanting to know what they can do in the way of mobile gear to put in their Volkswagen or Porsches, six volt cars. Topaz has six different six volt models available and they will handle most of the commercial transceivers and rigs. Drop a line to Topaz and get their detailed specs. 3802 Houston Street, San Diego 10, California. Tell 'em Wayne sent you.

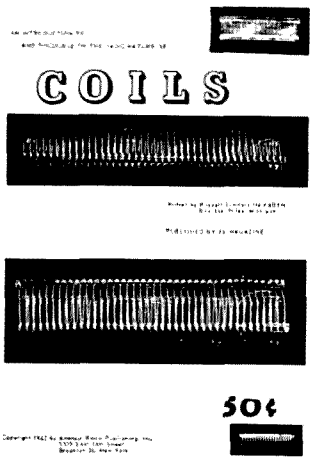


Crank-Up

Rohn has announced the availability of their #6 tower in a crank-up model in heights from 18 to 54 feet. It wouldn't hurt for you to drop them a note and find out more about this. Rohn, Box 2000, Peoria, Illinois. Tell 'em you read about it.



K8LFI has come up with a booklet on "Simplified Math for the Hamshack" that you mustn't miss. This booklet presents the simplest and most understandable explanation of the math that we need for ham radio work that we have ever seen. It covers with utter simplicity Ohm's Law, squares, roots, powers, frequency VS meters, L/C, logs, etc. It even introduces you to the slide rule. This will be one of the best investments you've ever made. 50¢



This little twelve page booklet will be an interesting addition to your library. It will not only give you quite a rounded body of information about all sorts of coils, but is a fine thing to whip out and show someone who is interested in learning about radio. Marvelously written by Russ Summerville K8BYN, it is also well illustrated. It covers all types of coils and discusses their resistance, inductance, reactance, Q, and distributed capacitance. only 50¢

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ARC-1 and ARC-4	24.00	HRO and 4 coils	95.00

VIKING Challenger, factory wired, like new	$95.00
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TCS XMITTER, Receiver and 12 V. supply	75.00
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D.F. Receiver, DAE-1 and loop	$35.00
VARIACS—5 amp.—$9.95, 10 amp.—$14.95, 18 amp.	24.00
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So OK. You work DX? Rag chew? Don't like QRM? Read on. If you use CW at all, full break-in is like the automatic transmission on a car. You can get along without it, but there's nothing like it.

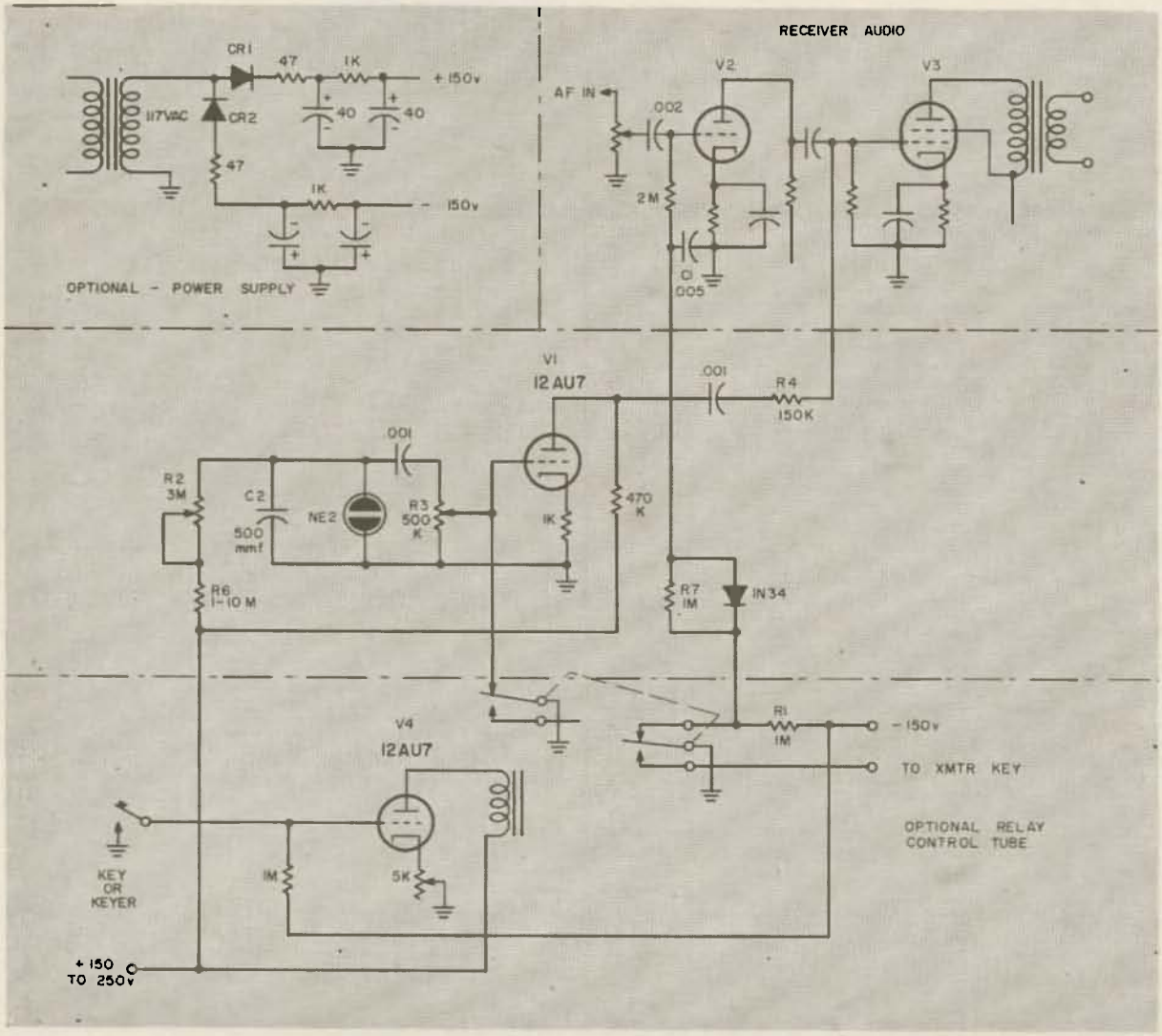
Full break-in is any system which will let you hear during brief pauses in your sending. It speeds your operating immensely. There are no switches to throw to go from send to receive. Hit the key—you're on. Let go—you're listening.

DX? You can hear other stations calling the boy you're after. Time it right, and your call will be the last one, and in the clear.

Rag chewing? You can hear that South American phone when he clobbers your frequency—and just stop sending until he drifts down the band a little. And the guy on the other end can stop you to tell you he's on the land-line, so "pse QRX."

Contests? Work 'em and log 'em. No switches to throw.

"Yeah, but what about all that racket in the phones—the clicks, squawks, grunts, blaats and



screeches? And besides, I don't like having to tune in my own signal all the time to monitor."

Relax. All that's solved. It takes one tube, one relay, a neon lamp and three diodes.

Here's how it works.

Audio Grid Block Keying

You just key the receiver. The audio part of the receiver, to be exact, so you don't hear all that racket. And feed in a "sidetone" to monitor your own keying.

That's all there is to it.

The keying is clickless, thumpless, squawkless and so fast that a strong station can "break" through a string of dots at 25 wpm.

The diagram shows how this is accomplished.

This is not a blow-by-blow construction article. Nothing is critical. It can be built on any convenient chassis, in any convenient nook or cranny. It can have its own power supply or can steal power from existing equipment.

Changes required in your receiver are very minor and you can avoid them completely, if you want to build an additional small amplifier. No changes at all are made in the transmitter, assuming that you're already keying the oscillator (or mixer of a heterodyne rig).

Power requirements are small. Filament voltage for one tube, 150 volts positive at 20 ma and 150 volts negative at 5 ma.

Cost? Nil, if you have a good junk box. Maybe $15 if you buy parts new and steal voltages from existing equipment.

How It Works

With the key open, V4 is cut off by blocking bias, no plate current flows and the relay remains open—resting. One pair of contacts of the DPDT relay short the grid resistors for V2 to ground and the stage operates as an ordinary audio amplifier.

The other pair of relay contacts shorts the grid of V1 to ground, preventing it from feeding any side tone to the audio output stage.

When the key closes, plate current through V4 causes the relay to pull in. This removes both the short circuits.

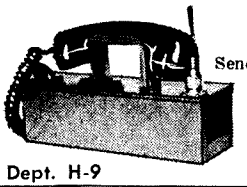
A hundred and fifty volts negative bias cuts off V2, so that it won't pass any of the audio arriving fom the receiver's demodulator ("second detector" if you like). At the same time, V1 is permitted to amplify the audio output of the little NE2 relaxation oscillator. And the output of V1 is fed to the grid of the receiver's audio *output* stage, which has not been affected by the blocking bias.

Thus, almost instantaneously, the receiver "goes dead" and the sidetone pops up in the speaker, or phones. When the key goes up, the reverse happens.

The Relay

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keyer, you can eliminate V4 and the relay altogether and use the keyer relay contacts to do the job. Most keyers, unfortunately, have a SPDT relay. And if you use a bug or handkey, you will need some means of operating the keying relay. This is about the simplest way to do it.

Sidetone Generator

Any kind of audio oscillator device may be used. An NE2 was chosen because it can work from voltage of either polarity, it is cheap, small, effective and requires no filament supply.

It will be necessary to fiddle with values of C2, R2 and R6 to get the audio pitch you like. R2 permits varying the pitch from the front panel. The bigger the resistance of R2 compared to R6, the greater range of pitch control you'll have. Different values will be required for different voltages. The values shown are about right to start experimenting with, for a voltage of about 150.

R3 permits controlling the volume of the sidetone from the front panel. Sidetone level in the speaker or phones is completely independent of the setting of the receiver volume control. It is determined solely by the setting of R3.

At the author's station, the whole unit is built into a home brew W9TO keyer chassis. The keyer already supplies all the necessary voltages, sidetone generator and amplifier.

Unfortunately, the TO keyer normally uses a SPDT relay, and this had to be changed to a DPDT unit.

It might be possible to use the circuit shown in Fig. 2 to use the SPDT relay in a TO keyer, for transmitters using grid-block keying. Transmitter bias is used to block the grid of the sidetone amplifier. I have not tried this approach, but it should work nicely.

Receiver Modifications

The only changes in the receiver are indicated by the broken-line box in the diagram.

You don't want dc bias voltages on your receiver volume control. It makes for noisy operation. So you isolate the arm of the pot with a blocking capacitor. Bias is fed to the grid through the 2M resistor shown. Exact value is not critical but should be approximately 3 or 4 times the value of the audio pot, because it is in parallel with it for audio. Too low a value would reduce the effective resistance of the pot.

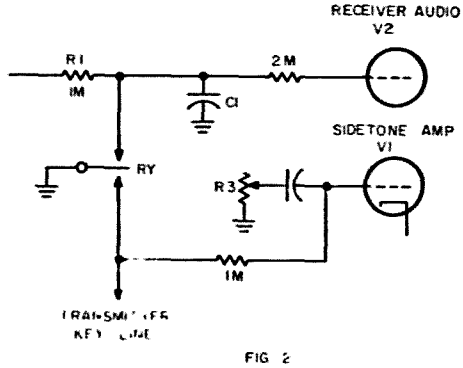


FIG 2

Sidetone is fed to the output stage through a shielded wire connected directly to the grid. R4 may be mounted in the break-in unit. Its value should not be too high in proportion to the value of the V3 grid resistor, since the two in series form a voltage divider for the sidetone audio voltage, with the grid tapped down on it. High values of R4 will result in low sidetone levels. R4 may not even be strictly necessary but it probably helps keep down injection of tube noise and hum from V1.

If you don't want to tear in and modify that new $1200 Super Gizmo receiver, you don't need to. Just build a simple two-tube audio amplifier and feed it from the receiver headphone jack. Then key the grid and feed the audio tone to the outboard amplifier.

Key Shaping

Without some kind of key shaping, the rapid make-break of the blocking bias on the audio grid could produce clicks. We don't want these.

The solution is key character shaping with an RC network. (Or the use of an audio peak clipper in the following stage.)

This is the function of R7, the 1N34, C1 and R1. When the key goes down, bias is applied to the grid through R1 and R7 in series. But it must charge C1 first. The higher the combined resistance of R7 and R1, and the larger the capacity of C1, the longer it takes the bias to reach the value required to cut off the tube.

If it reaches this value too quickly, a click results. If it reaches this value too slowly, a click or squawk results, because the transmitter may come on before the tube cuts off.

Because of the polarity of the 1N34, its *forward resistance* (very low) shunts R7. So the charging time is determined almost entirely by R1 and C1. Charge time should be made as short as possible without producing clicks on the "make."

When the key is lifted, C1 discharges to ground through R7. But this time, the high *back resistance* of the diode shunts R7 and the effective value is approximately that of R7, so C1 discharges slower than it charged, for high values of R7, and faster than it charged for low values of R7. If the resistance of R7 is zero, discharge is virtually instantaneous. This could produce a click. If discharge is too slow, the receiver won't "open up" quickly between letters.

It is not possible to give exact values for R7, R1 or C1. They will be different for each audio tube which may be keyed, and they will be different for different values of bias voltage.

In general, they should be adjusted to give the fastest keying possible without clicks. The value of R1 must be kept above 500K because

when the key is up, R1 shunts the bias supply as a bleeder. Too low a value will overload the supply or overheat the resistor.

Receiver Front End Protection

A TR switch will work fine to keep damaging amounts of rf out of the receiver's front end. I use a separate receiving antenna, however, and I protect the receiver with a pair of 1N34's connected back to back, across the antenna terminals. Transmitter input—up to 1 KW.

At very low voltages, the 1N34's have very high resistance, both in the forward and back directions. They have no effect on receiver performance.

When high rf voltages are present from the transmitter, however, they conduct heavily and the receiver behaves as though the antenna terminals were shorted together. Simple, but effective.

Many hams use an NE2 or NE1 across the antenna terminals for the same purpose.

Comments

Like every construction project, no matter how simple, this one has three phases:

(1) putting it together
(2) figuring out why it doesn't work
(3) Getting it to work right.

It's a real pleasure to be able to tell the guy on the other end "QSK HR OM." . . . W4MLE

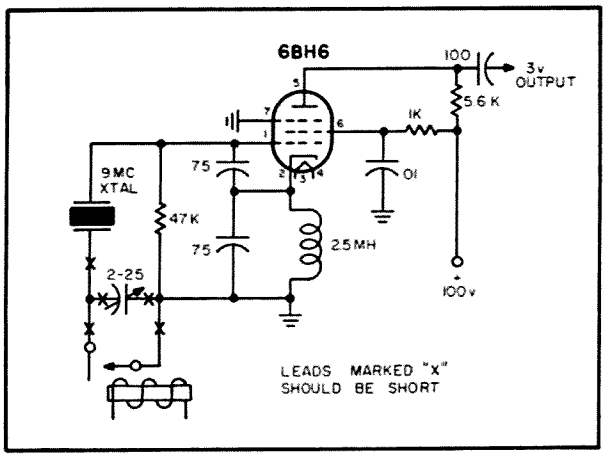
FSK a 9mc Osc.

Here is a circuit developed for frequency shift keying a 9 mc Crystal Oscillator.

The output of this oscillator feeding into a 9 mc SSB rig replacing the output of the 9 mc SSB Generator will give the 850 cycle shift required for RTTY.

Closing of the contacts produces the higher tone, the lower tone being set by adjusting the 2-25 mmfd condenser. The frequency shift will remain the same on all bands.

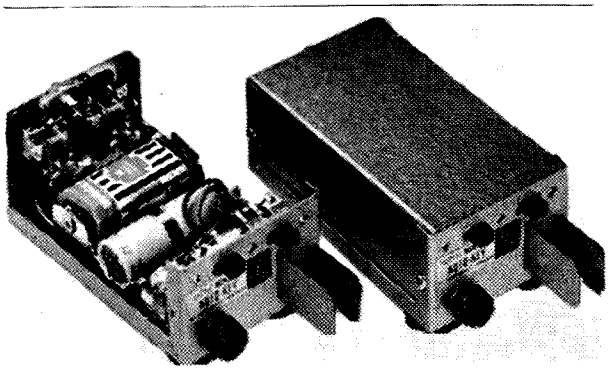
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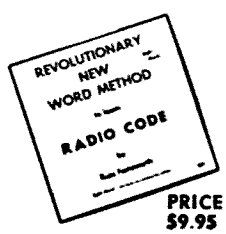
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The Frequency Response Argument

A New Approach

James L. Tonne W5SUC

THERE are probably as many opinions among phone operators as to the "best" frequency response for a transmitter as there are phone operators. Those who bought their equipment could care less, but the fellows who roll their own are sometimes highly concerned, since they have the power to alter components to achieve better results—embarrassingly enough sometimes better than that pretty store-bought thing.

There are books by the boxful telling how to adjust your equipment for the most potent-sounding signal. And the best of these were written by fellows who did the testing under the most favorable possible conditions with some of the world's finest test equipment.

That's where the rub comes in—they didn't run their signals through a transmitter and receiver. And that is a highly important step, chiefly because of the limited amount of audio power that the transmitter can handle. When these boys did their testing they did it with signal sources feeding amplifiers that could very easily drive the headphones that the listeners wore. Although some electrical noise may have been added to the signal, everything was kept very linear. This is very fine for the lab, but when it comes to testing a new-found frequency response curve over the air, that signal is definitely going to run through a transmitter with limited modulation capabilities and a receiver with a very definite effect on the signal.

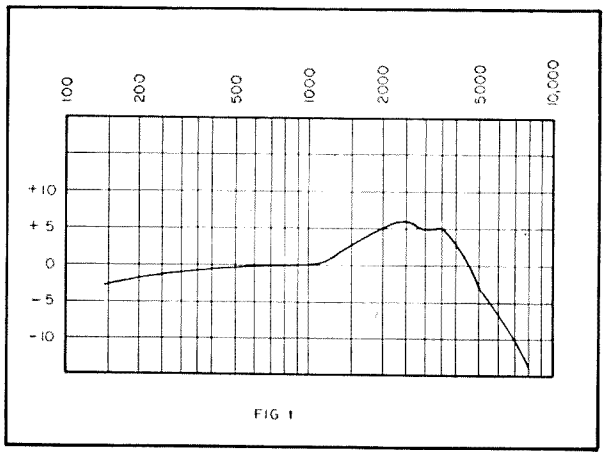


FIG 1

So here we go—at complete odds with the "authorities."

Ye writer has built and operated a number of amateur band transmitters, most of them using modulation techniques of high quality. Usually plate amplitude modulation was used, sometimes efficiency (screen grid) modulation was employed. In each case, the optimum frequency response to transmit was radically different from that which it is commonly supposed is best. By the way, don't laugh at "high quality" being used in the same paragraph as screen modulation. KFI in Los Angeles, WOAI in San Antonio, WCKY in Cincinnati and KDKA in Pittsburgh all use screen modulation. Distortion? In the vicinity of 1%.

Frequency Response

Let us suppose that conditions over the communications path are more or less ideal, and that a good signal to noise ratio exists, say in excess of 15 or 20 db. The receiving operator will doubtless open up the bandwidth of his receiver in order to let more of the high frequency components come through. He will do this until the signal to noise ratio of the signal as received begins to decline. Seldom will the receiver be allowed to receive components beyond 4000 cps.

It has been found by the writer that the high frequencies do contribute considerable intelligence, but that components above 4000 cps are to be considered secondary in importance, rather than above 3000 cps as commonly published. To be ethical it is advisable to cut off components that will definitely fall outside the passband of the receiver at the receiving end.

Reducing the frequency response on the low end will increase intelligibility of the signal, since the low end of the speech range has the highest amount of power, and this range additionally contributes less to the signal intelligibility for the amount of power it contains than the high end. But cutting out the low frequencies entirely is not proper, as can be shown.

If the goal of this deliberate alteration of the frequency response is to make all frequencies have about the same amplitude, then the proper thing to do is to install an equalizer which mirrors the speech distribution. Such an equalizer can be fabricated quite simply by using a high frequency boost of about 12 db/octave above 1000 cps. The boost should cease at about 3000 or 3500 cps. Such a scheme will produce much better results than cutting out the lows, and the two results will sound quite different. Boosting the highs is considerably easier to listen to, especially under adverse conditions.

Such a frequency response, flat on the low end and rising on the high end, is to be highly recommended.

Suppose now that instead of boosting the highs we cut the lows. Suppose further that we cut everything below 800 cps, as has actually been proposed. The audio level of the signal as received is now critically dependent on the bandwidth of the receiver at the receiving station. If the receiver is quite wide, sufficiently so to capture all of the sidebands, then the signal to noise ratio will be poor because of the interference and noise that probably will be on the channel. But if the bandwidth is reduced, the modulation percentage of the signal as detected is cut down. It is this very same reduction of modulation percentage by the *if* strip that causes so much trouble with oscilloscopic modulation checks by the receiving operator. He will consistently give out low modulation percentage reports which will disagree with the transmitter operator. And yet both are correct—if you remember that the receiver will actually reduce the high-frequency modulation percentage as received. Indeed, if everything below 800 cps is removed at the transmitter and all above 800 cps is removed at the receiver through the *if* selectivity, then there will be nothing, but nothing coming out of the receiver's loudspeaker. Nothing, that is, but noise. For it has been proposed that such an extreme cut of the low frequencies as transmitted be used under extreme circumstances. And under extreme circumstances the receiving operator will no doubt sharpen his selectivity. Hence little of the modulation will be detected.

Whereas if some of the low end is left intact, albeit reduced, then the receiver would have something left with which to play regardless of the amount of selectivity used.

Distortion

In practice it is found, provided that the modulation system is nearly distortionless, that

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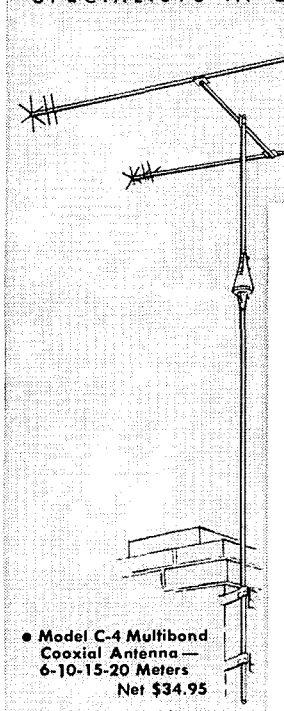
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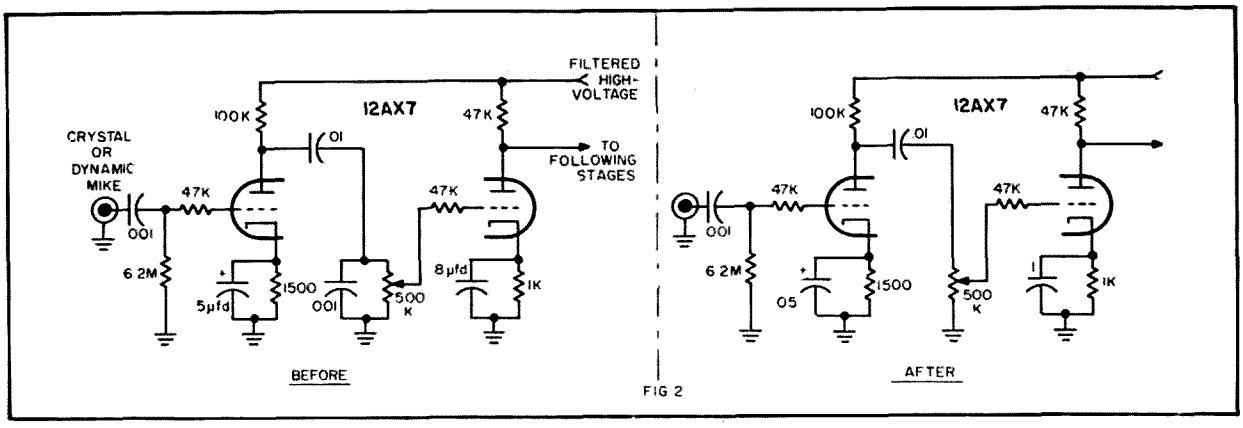


FIG 2

the low end should be preserved as carefully as possible. To make up for the losses in the rest of the system, it might be advised to actually raise the response on the low end, particularly if a carbon microphone is to be used. This must be done very carefully. Distortion must be kept to a low level, preferably at the vanishing point. The degree of distortion that is allowable depends chiefly on two things: the amount of reduction in intelligibility that results from a high degree of audio nonlinearity (distortion), and secondly the increase in bandwidth that results from distorting the audio signal.

If the high frequencies are distorted, as for example if a 3000 cps signal developed some 3rd and 5th harmonic distortion, the intelligibility would not suffer in the least. That's because 9000 and 15000 cps signals will not be passed by any modern day receiver. The fact that remains is that the signal as transmitted will be broad, even if overmodulation does not occur.

If such a high frequency distortion occurs, the only way that these components can be detected is by tuning off to the side of the signal. Their presence will be most obvious. The signal will have the so-called "hairy" sidebands.

If the low frequencies are distorted, this is the cause of some very irritating intermodulation troubles. Unfortunately, the low frequencies are most difficult to keep distortion-free if economy enters into the picture at all. Large amounts of iron are required in the modulator and the power supply must be capable of handling the low frequency components. If the low frequencies are distorted, then the high frequency components "riding on top of" these signals will be distorted too—sometimes to the point of non-intelligibility.

A distortion figure of 50 db down would be gladly accepted by most broadcast stations, whose typical distortion at 100% modulation might run from 1 to 3%. So if you can make your signal sound of BC quality, then you are on the right track as far as distortion is concerned.

Circuitry

Of probable interest is the frequency response curve of the newer telephone sets—the Type 500. See Fig. 1.

Methods used to boost the high frequencies are very simple. If the speech amplifier has a little gain to spare, merely remove one of the cathode bypass capacitors and replace it with a smaller value—typical values run from .025 to .1 mfd, depending on the value of the cathode resistor. Do this for 2 or 3 stages and you have it made. Or you can use a simple voltage divider with a small capacitor to shunt the highs around it, as in Fig. 3. If any of the low level stages have a capacitor from some point to ground other than cathode or screen, remove that capacitor as it is reducing the high frequency response.

If you want to increase the lows, remember two very important things: first you'll probably raise your hum level, and secondly the modulator must be clean as a whistle in order to handle the lows without distortion. If you can borrow distortion checking equipment, by all means do so.

In Summary

Don't cut out the low end entirely. It is

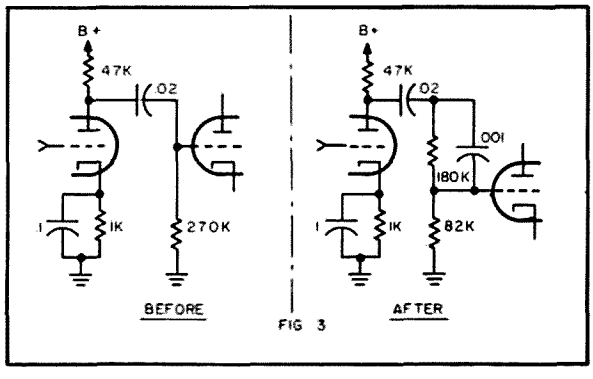


FIG 3

best to boost the highs instead. But frequencies above 3000 cps are not too important, and those above 4000 need not be transmitted at all.

If the audio system has poor low frequency response, make up for that and get the overall response flat on the low end. Then, if the receiving operator uses considerable selectivity, your modulation will still hold up.

Keep distortion at the vanishing point. Operate the transmitter conservatively. This will make your signal cleaner, which makes for higher intelligibility and also uses less spectrum.

Just because the other guy has a miserable signal is no reason for the rest to follow suit.

. . . W5SUC

(How's my What? from page 31)

ments are at each other's throats. And while the diplomats in what may be a generic twilight grope for omens in their chicken entrails, what messages do we send around the world? RST. QSL. CUL.

Germane to all this moaning I've been doing about taking up the slack in the bonds of mankind is an uncomfortably illustrative personal experience. In June of 1941 I was sloping around the deck of a freighter docked at Shanghai. Classy Japanese destroyers were hot-rodding in the river and Imperial Marines with fixed bayonets patrolled the miserable streets while I enjoyed the Chinese summer sun. A blonde youth came up the gangway and asked me for a job. Impossible. He hesitated and then said he had a Telefunken short wave receiver to sell. We discussed this and he told me that he had had a ham station in Germany. There was other gear for sale too and we talked shop for quite a while but we didn't come to terms in the way he had hoped. However I think we did later, in another sense, after I learned how many European refugees were trapped and desperate there on the mud banks of the Whangpoo, selling everything they possessed for food. I should have guessed, but I let him walk away. When it was too late to think of the man I remembered well how curious I had been about his receiver. That was a long time ago, but the memory is sharp and clear. For impact nothing beats sudden illumination of your image.

At your expense I've deferred applying "Green's Principle" in favor of another rule: "When you have an uncomfortable thought, share it." And the best answer I have to the question asked by K7NZA is: "About the same as the average ham's, but I'm working on it."

. . . W7IDF

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(W2NSD from page 59)

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August 1961 Issue

In the August issue last year there were 18 feature articles, all of which are still of topical interest. The article that created the most interest was our evaluation of the Drake 2B receiver. Drake hasn't yet caught up with the demand for this receiver. John Reinartz K6BJ came up with a clever little piece of gear, a frequency deviation meter . . . simple to build and impressive to use for net operation, etc. Irving has a printed circuit available for this one if you want. He also has one for the W3BUL noise limiter in the same issue. W8GUE passes along some hints and encouragement on the use of the bi-square beam. This issue also had one of the best RTTY converters we've ever seen in print. This one, using a simple printed circuit board, is completely transistorized and really could be built into most printer cases if you wanted to. The board is available commercially for $2 and the toroids are $2 for the pair. One of the better two meter nuvistor converters appeared in the August issue. This one has been repeated in most of the other radio magazines by now. The big construction project in this issue was the RF Impedance Bridge by K6CRT. We have made sets of full scale plans for this one and have sold hundreds of them at $1 per set. This bridge is essentially the equivalent of one of your $400 commercial bridges, but can be built for a few dollars when you have the plans.

The A-B-C's of radio are pretty simple when you read the Kyle article on the different classes of amplifiers. W2BXE shows us a novel transistorized power supply which uses two six volt filament transformers instead of the expensive specially wound jobs usually called for. W3UZN's test of the Finney 6 & 2 meter beam is thorough and should have you looking it up in the catalogs and ads. Kyle came through with a fine treatise on noise, defining the differences in types of noise and explaining the various methods of coping with each basic type of noise. Very edifying.

We still have some of the August 1961 issues of 73 on hand and they will be sent to you for the regular back issue price of only 50c. While you're at it you might also want to get one of the September 1961 issues. Same price.

The big technical article in September is on crystal oscillators. By the time you get through a working description of all of the different types of crystal oscillators in common use you will be able to give an authoritative lecture at the club. The article is written for the newcomer and won't panic even a Novice. W1OOP has a fine article on silicon rectifiers. Both engineers and amateurs are warned to be sure to read this one before they start flinging these rectifiers into their rigs. Hank has learned a lot about how not to pop 'em, so learn from him . . . it's cheaper. There are a dozen or so more articles in this issue, just send for it it you missed it the first time around, you'll enjoy it.

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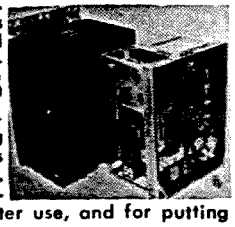
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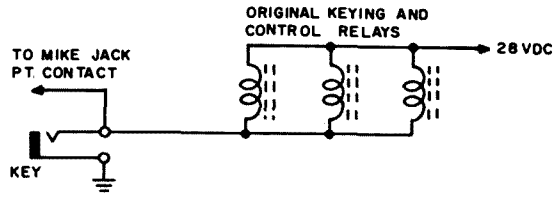
A Surplus Conversion Keying Circuit

Photograph by Morgan Gassman, Jr.

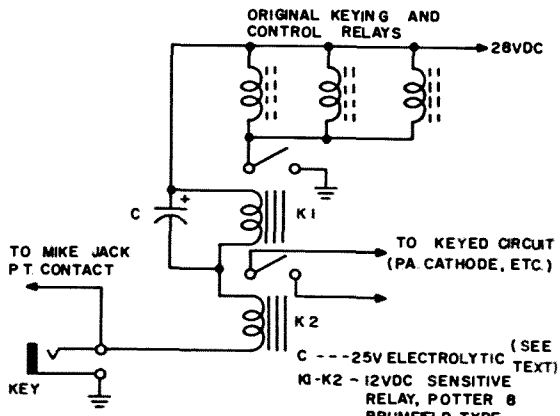
Roy Pafenberg W4WKM

MOST surplus transmitters are provided with extensive relay circuits and this concept is carried into the area of carrier control and keying. Numerous functions are performed by these relays in addition to simple interruption of the carrier for CW transmission. Also, some real monsters were used in much of the older equipment to meet the severe altitude and vibration requirements of aircraft radio service. While these relays *will* follow slow speed CW keying, the resulting clank and clatter is not conducive to a happy home life. Further, many of the relays used will not follow a bug with any degree of faithfulness.

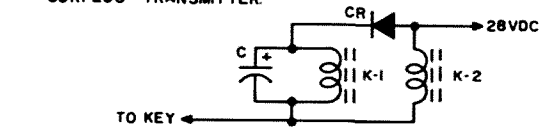
The wiring complications attendant to the generous use of relays makes it difficult to completely redesign and rewire the control circuits in most surplus equipment. The draw-



(A) ORIGINAL KEYING CIRCUIT OF SURPLUS TRANSMITTER.



(B) MODIFIED KEYING CIRCUIT OF SURPLUS TRANSMITTER.

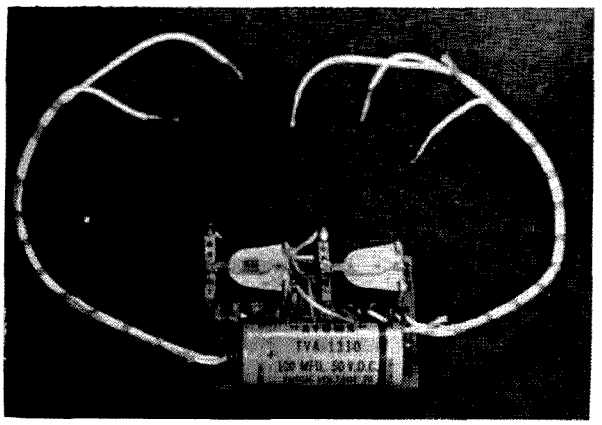


C ---------- 25V ELECTROLTYIC (SEE TEXT).
CR ------- SILICON DIODE, ANY POWER TYPE.
K-1 - K-2 -- 28VDC SENSITIVE RELAY, POTTER & BRUMFIELD TYPE RS5D OR EQUAL.

(C) MODIFIED KEYING CIRCUIT ADAPTED TO 28VDC RELAYS.

ing shows a typical surplus transmitter keying circuit and a couple of answers to the problem. In both cases, a small relay subassembly is inserted between the key and the original keying circuits.

The assembly shown in Figure B consists of two sensitive 12 volt dc relays with the coils in series and a capacitor connected across the winding of K-1. When the key is closed, this relay operates, locking up the original keying relays. When the key is opened, the capacitor charge holds K-1 closed for a period of time dependent on the value of the cacpacitor and the relay characteristics. Each closure of the



key recharges the capacitor and the time constant is chosen to be such as to hold the relay closed between characters and words. The value of the capacitor must be determined experimentally and will range upward from 10 mfd. With the relays specified, 100 mfd proved satisfactory. The second sensitive relay, K-2, follows normal keying speeds and the contacts of this relay are connected in a part of the circuit that will allow satisfactory high speed keying. The choice will depend on the design of the transmitter and, to a large degree, personal preference.

If 28 volt sensitive relays are used, they must be connected in parallel as shown in Fig. C. In this case, the lockup relay and capacitor are isolated by a silicon diode. Polarity is such as to allow the relay to close and the capacitor to charge. When the key is opened, the diode blocks the flow of current and prevents K-2 from being held closed.

The photograph shows the series version of this circuit, using Potter and Brumfield RS5D, 12 volt dc relays, ready for wiring into an AN/ARC-2 conversion. Both of these circuits preserve the original "break-in" features of the equipment, allow minimum change to be made to the original wiring and greatly reduce the mechanical noise level of the converted transmitter. . . . W4WKM

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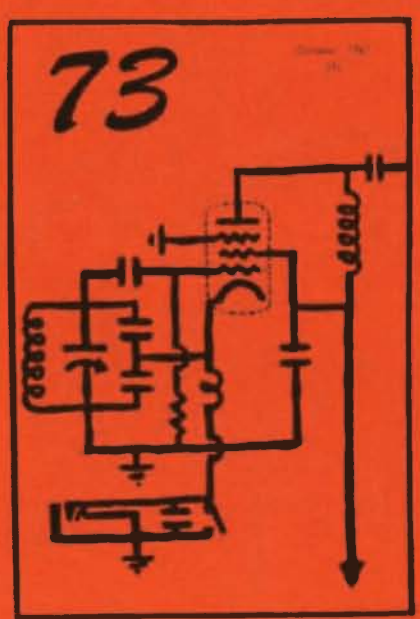
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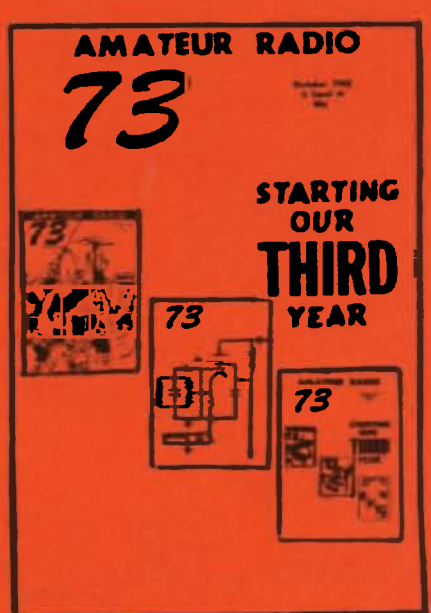
73

October 1962
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STARTING OUR THIRD YEAR







73
Magazine

Wayne Green, W2NSD
Editor, etcetera

October, 1962

Vol. XI, No. 1

Cover: WIMEL.

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The cheapest really hot VHF converter yet published.

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de W2NSD/1

Never Say Die

In spite of what a slightly more paranoic person might be convinced was an obviously well organized scheme to keep 73 virtually unknown, we are starting on our third year of publication. An awful lot of friends (?) were convinced when I started that I couldn't possibly make a go of the magazine. Though they were not far from wrong, they were (bless their hearts) kind enough to explain all of the pitfalls in detail so I would be sure and not miss any. I haven't. They were perhaps overly concerned with the fact that we could not advertise 73 in QST or CQ to let the amateurs know that a new magazine had been started. They reckoned without the power of over-the-air advertising from satisfied hams and the impact of writeups in club bulletins and discussions at ham club meetings.

It is plain to see that my formula of running an overwhelming number of technical and construction articles, salted with irritating editorials, is a successful one. We'll keep it up.

One factor that caused the most apprehension was the artificial ceiling on advertising space costs imposed by QST's ad rates, which are about one third those normal for a periodical of their circulation. This, more than any other factor, has held down the number and size of ham radio magazines and has resulted in the failure of most publishers who have tried to enter the field. I felt that I could surmount this difficulty by keeping publishing costs to a minimum (no staff) and by charging fairly high subscription rates. It is a bit discouraging to publish a magazine and have trouble selling ads for $165 a page when magazines in other fields are getting well over $1000 a page for the same circulation!

However, if you continue to buy our advertisers products at the rate you have been, even some of the curmudgeon manufacturers (non-advertisers) may see the light. You may notice that several advertisers, after checking their dollar results against advertising costs, have virtually dropped out of other magazines.

Perhaps you think I dwell unduly on advertising. Well, if you could see how many articles I have to refuse because of limited pages (you do see some in the other magazines since we seem to get first choice on articles), you might share my concern. We could easily publish a magazine twice the size of this issue if we could get the advertising to make it economically feasible. Every time you put in a good word for 73 with an advertiser or prospective advertiser you will be helping.

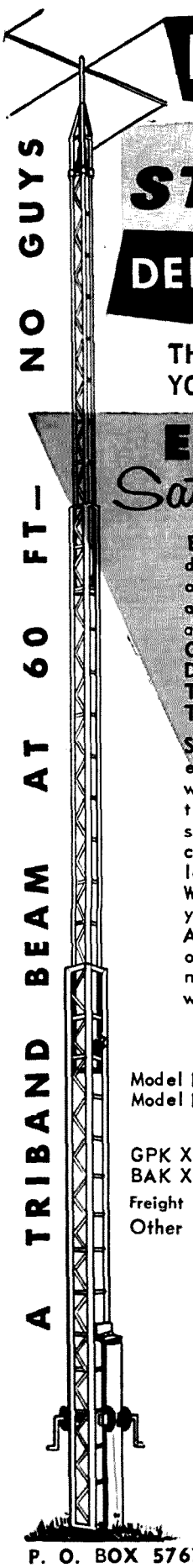
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Inertia

I remember a fellow that I used to work every night on 75 meters. W2MSZ. Dexter was the first contact I ever made, matter of fact. Fresh and dewey with my new license and a little 2½ meter transceiver, I called a CQ. W2MSZ came back to me. I walked, transceiver in hand, the mile and a half to his house. Anyway, Dexter had an old ac-dc "communications receiver" which drifted and was as broad as a barn door. He talked interminably about the latest receivers on every QSO and every personal meeting with a ham. He decided a hundred times to get an HRO. Dexter finally died, never having had anything better than that frustrating old ac-dc. Inertia.

Most of us have things that we would really like to do, things we can afford, but just never get around to. Oh yes, it is easy to rationalize putting things off. Next year things will be better. Next year they may come out with a new and radically better receiver. Next year we'll have more time to go places. Good old inertia.



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With even a small amount of inertia I never could have started 73. And how about Virginia and I going to Europe back in April? Can you even imagine the number of arguments we could come up with to hold us back? Any normal person knows that it is impossible to walk off and leave a monthly magazine that has been taking your every minute for a year for a full month tour of Europe. We did it though and though this slowed down the expansion of our advertising a bit, there were few other penalties. A few subscriptions got mixed up, a few hundred letters didn't get answered, and I got even further behind on processing articles. But we did get to Europe and we had the time of our life. We would have traded ten times the difficulty for what we got.

What is all this leading to? Not much, really. I just wanted to get across an idea and perhaps blast a few fence sitters loose. If you want a new receiver then go out and get it. By next year you'll find that the Dream Receiver still isn't on the market and you've had a year of a lot more fun in operating than you would have had sticking it out with the old box. Travel? Just make the decision and then set about solving the problems to make it possible.

I'm still figuring on setting up a ham flight to Europe next fall. The more I think about it the more I like the idea. It seems to me that a three week trip would be about right. A month would be better, but this might be as hard for other people as it would be for me. Two weeks isn't worth the trouble. In three weeks we can do a rather good job of visiting five major cities. I have in mind London, Paris, Frankfurt, Geneva and Rome. Though I haven't even started with the airlines yet, I suspect that we can keep the price to an amazing minimum, something on the order of $500! This seems like a lot, but it would include jet flight first class both ways and hotels in all cities plus most meals. There shouldn't be much more needed.

Getting a little enthused? Well, the first step will be in a month or so when we form a little club. You'll have to be a member of this club for a while before you can make the trip. And if any fellows in London, Paris, Frankfurt, Geneva, or Rome read this and are interested in helping to set up a welcoming committee for us when we pour in next year I'd like to hear from them. I'm hoping that the clubs in these cities will be able to work up a hamfest so we can all get together. The dates aren't set yet, of course, but I had in mind around

(More on page 77)

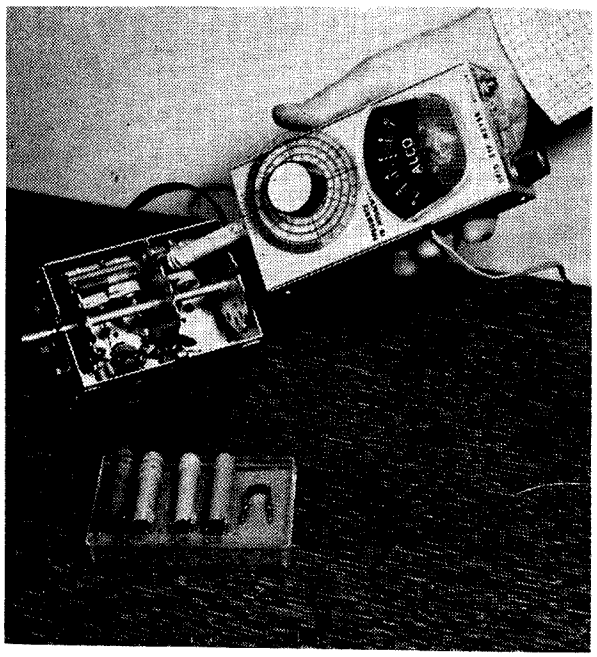
Do you have a suppressed desire to hop about the VHF bands? Here is the way to do it at no cost and with little effort.

VHF'ing with the Standard Coil Tuner

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photos: Morgan S. Gassman, Jr.

IF you are one of the amateurs who has never explored the spectrum above 30 megacycles, you owe it to yourself to see what is up there besides Channel 5. Any one with a general coverage, high frequency receiver and a free evening can provide himself with a reasonably good converter that will tune any twelve, 2 to 6 megacycle bands between 30 and 300 mc.



By removing all the coil strips except the one being tuned, it is possible to grid dip each rf winding and the if output transformer.

Literally millions of older model television sets are being junked each year and a large percentage of them are equipped with Standard Coil turret tuners. These TV front ends are true engineering masterpieces and, to make a comparison with the automotive industry, combine the best characteristics of the Model T and the Rolls Royce. Rugged, reliable, easy to maintain and mass produced at low cost, they have outlasted the receivers in which they were installed.

Almost every TV shop has a steady turnover of junk sets equipped with Standard Coil tuners and they may be had for the asking or for a token charge. These tuners fall in two general categories, those using a pentode and those using a dual-triode, cascode rf stage. While the cascode tuner, using a 6BQ7 or 6BK7 tube is preferred, the pentode type is usable and will give acceptable performance. While you are at the TV shop, try to locate the schematic of the set and copy the tuner diagram.

While these tuners are all essentially alike, each set manufacturer had his own specifications for *if* output circuitry, mechanical mounting details and supply voltages. Incidentally, we are dealing only with the older model tuners that used the nominal 21 mc *if* frequency. While not too many sets using the modern *if* of 45 mc are being junked yet, check and be sure since these would require substantial modification. W1ICP, in recent QST articles, has treated the amateur application of junk TV

components in considerable detail. If you pick up the entire chassis, you are referred to his excellent articles.

The photographs and the exploded drawing show the physical characteristics of the older Standard Coil tuners. Figures 2 and 3 give the circuit diagrams of the two most popular models. As mentioned, considerable difference exists in output coupling networks. Some have a single, broad band, link coupled *if* output transformer. Others have separate video and sound *if* output circuits. Still others use a broad band pi network in which cable and tube capacitance comprise the output capacity.

In any event, the plan of action is similar. Dismount the tuner from the TV chassis. Remove the tube shields, tubes and bottom cover, setting them aside for future use. Remove the bracket securing the fine tuning disk and discard both the bracket and fine tuning shaft. Remove the spring clips holding the turret in place and pull out the drum. Remove all coil strips from the drum and clean all parts, using solvent as required. Clean and polish all coil strip and turret coil contacts using one of the electronic grade cleaning solvents. Inspect the 300 ohm antenna lead and replace, if required, using a 2′ length of new twin-lead. Removing the side plate will give access to the connections.

The external power leads are terminated on feed through capacitors mounted on a shield plate that divides the tuner chassis. Remove the old leads and connect new, 5′ stranded leads. Solder a ground lead to the shield plate and route these leads through the chassis holes used for the old wiring.

Inspect the *if* output circuit of your tuner and if it is already wired as shown in Figure 4D, simply replace the old output cable with a 6′ length of RG-58/U coax cable. However, if the circuit is similar to that shown in Figures 2 and 3, further work is required. Remove the coupling capacitor, shown as C18 in the diagram, and rewire the output circuit in accordance with Figure 4D. Wind a 3 turn link on the cold end of the coil and connect the 6′ length of cable. Temporarily install the 6J6 mixer tube and shield and, using a grid dip meter, tune the output circuit to 22.5 mc. If resonance cannot be reached, pad the coil with a small capacitor of between 5 and 15 mmfd until the coil peaks at the desired frequency.

In the unit shown in the photographs, the tuner is mounted on the front panel of a 6″ x 6″ x 6″ aluminum utility box using ½″ internally threaded brass standoff posts. Install the standoff posts on the tuner and transfer the

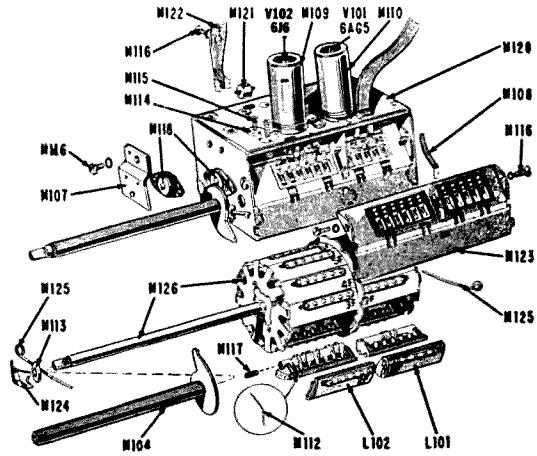
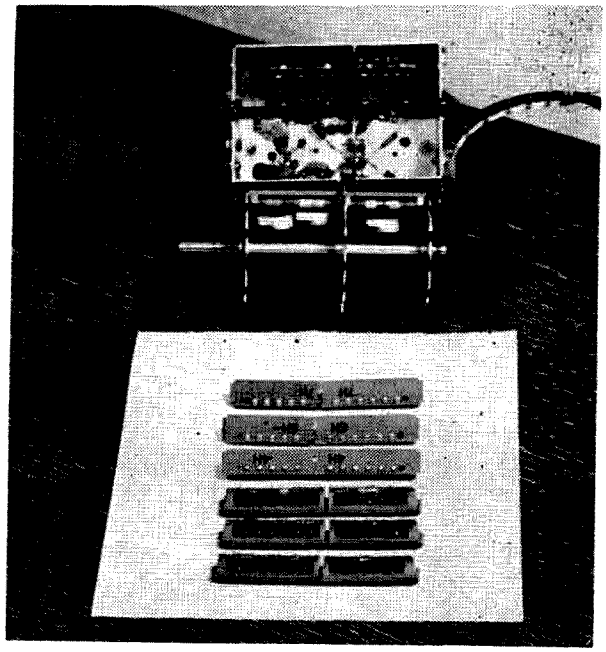
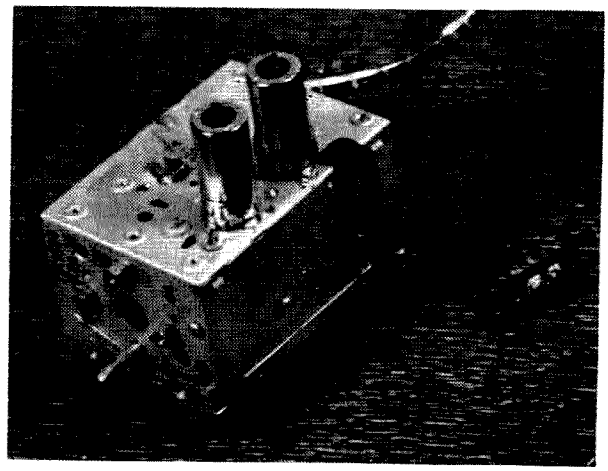


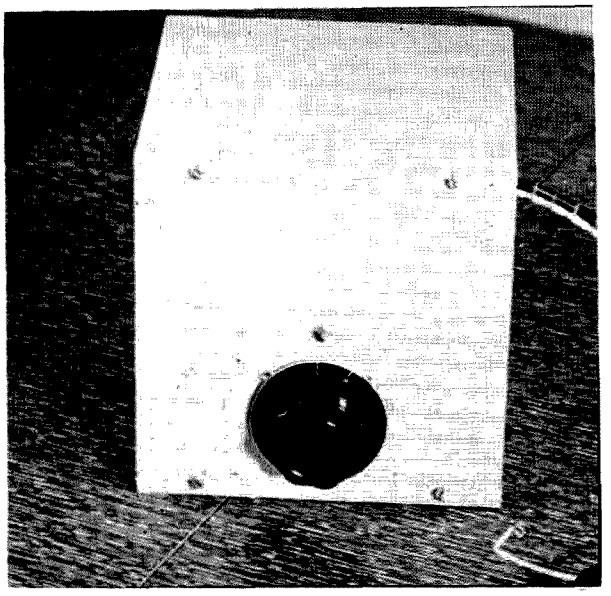
Fig. 1: Exploded view of a typical Standard Coil tuner used in an early Admiral chassis.



This view shows the turret drum removed from the tuner with the 6 meter coils in place. The other coil strips are shown ready for the "treatment."



The converted Standard Coil turret tuner ready for mounting in the utility box cabinet.



This view shows the packaged converter ready to go. The tuner is secured to the panel of a 6" x 6" x 6" utility box, using standoff posts. The octal plug is inserted in the receiver accessory socket and the PL-259 connected to the receiver antenna jack.

locations of the mounting, shaft and oscillator slug adjustment holes to the front panel. Drill the holes, reassemble the tuner and mount on the panel. Cut the shaft to length and install a suitable knob. A snap hole plug may be used to fill the oscillator slug adjustment hole.

Power may now be applied to the tuner. A separate power supply may be constructed or power may be stolen from the station receiver. In the unit shown in the photographs, a plug is installed to match the accessory socket on the receiver and the AGC lead was brought out for connection to the diversity AGC terminal which is conveniently available on the AR-88 receiver used for these tests. If AGC operation is not desired, use one of the optional circuits in Figure 4. While extremely strong local signals may cause blocking of the

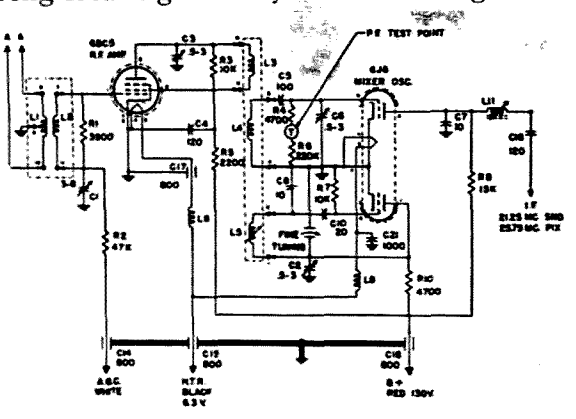


Fig. 2: Schematic diagram of the Standard Coil Model TV 1000 series pentode tuner. This circuit is typical of the early tuners using a pentode rf stage.

tuner if the AGC lead is grounded directly, this condition is rare. The B+ voltage requirements are fairly critical so check the service data on the set from which the tuner was removed and insert dropping resistors to bring the voltage down to the proper value.

With operating voltages applied and the tuner output cable connected to the receiver antenna jack, the converter may be checked out. A good outside TV antenna may be used for test and alignment of the converter and the broad-band characteristics of the conical

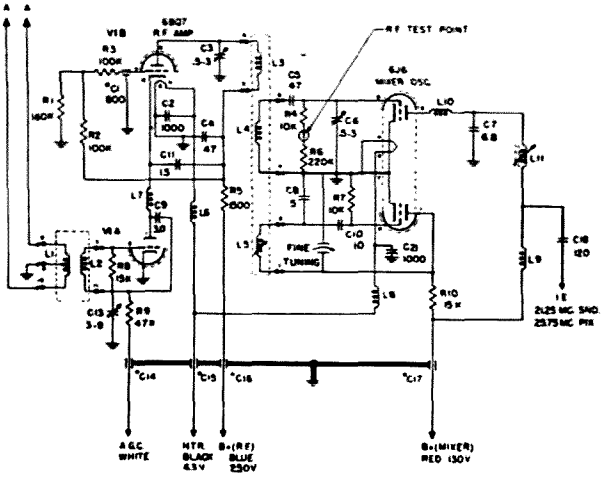


Fig. 3: Schematic diagram of the Standard Coil Model TV 2200 series cascode tuner. This model, along with the others, was subject to many variations in the if output circuit. Also, tube heaters were series connected for use in line operated sets.

type make it ideal for this purpose. Tune the station receiver to 21.25 mc and insert coil strips for a local TV station. Adjust the channel oscillator coil slug to bring in the sound carrier. Since the fine tuning control has been removed, substantial change in slug setting will be required. Now tune the receiver up in frequency to 25.75 mc and video information should be heard across this frequency range. When you are convinced the converter is working properly, you are ready to explore.

A stock of wire, small trimmer capacitors and a small soldering iron are desirable; a grid dip meter is almost essential. The techniques used are shown in the photograph. The example shown is a Channel 2 strip padded down to cover 50 to 54 mc. The rf amplifier grid and plate coils are shunted with 7-45 mmfd ceramic trimmer capacitors and adjusted, using a grid meter, so that the circuits resonate in the center of the band. The oscillator coil slug is now set to the center of its travel and the oscilator grid coil shunted with a 4-30 mmfd ceramic trimmer. The circuit is then adjusted to the nominal *if* frequency plus

the 6 meter band center frequency or 75.5 mc. The 6 meter band is then tuned on the station receiver between 21.5 and 25.5 mc. Any favored frequency may be peaked with the slug in the converter output coil.

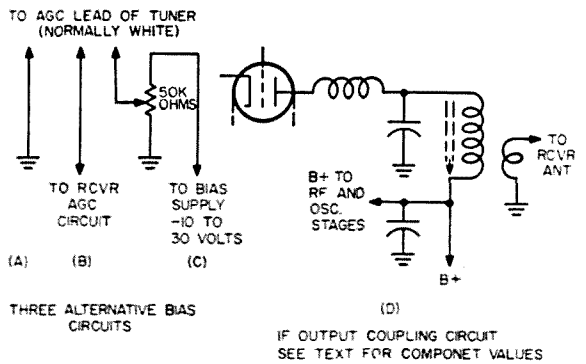


Fig. 4: Three solutions to the tuner bias problem are shown and each has its advantages. See text for discussion. The if output circuit shown is found in some models of the Standard Coil tuners. This circuit is ideal for feeding the low impedance antenna input of your high frequency receiver. See text for details on changing the circuits shown in Figs. 2 and 3 to that shown above.

The same techniques may be used to cover other frequencies. The Channel 7 coils are easily brought into the 2 meter band. Simply add one turn to the rf, mixer grid and oscillator coils, or add small shunt capacitors to these windings. Unless the frequency change is great, in which case the bandwidth would be reduced substantially, it is generally easier to add capacity to the tuned circuits than it is to rewind the coils.

This article outlines the basic techniques. Shortage of time precluded preparation of more elaborate coil winding data. Pick your frequency, fire up the grid dip meter and soldering iron and go to work. I am quite sure that the Editor would be quite receptive to a short article giving complete coil winding data for the entire spectrum from 30 to 300 mc, and this is entirely practical. The technical amateur is famous for his ability to parlay zero cost equipment investment into state of the art performance. While the performance of this converter makes no claim of being state of the art, this project provides a good method of getting a lot of no-cost experience in VHF techniques. . . . W4WKM

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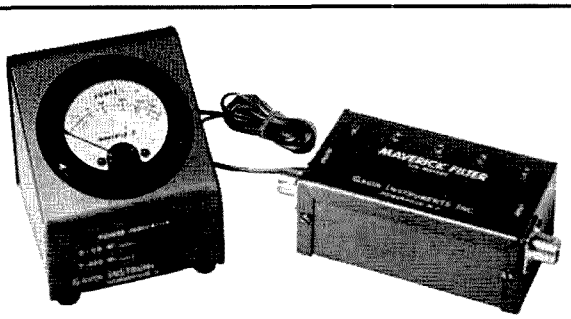
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Slant Face. Reads 0-50. 0-400 watts.
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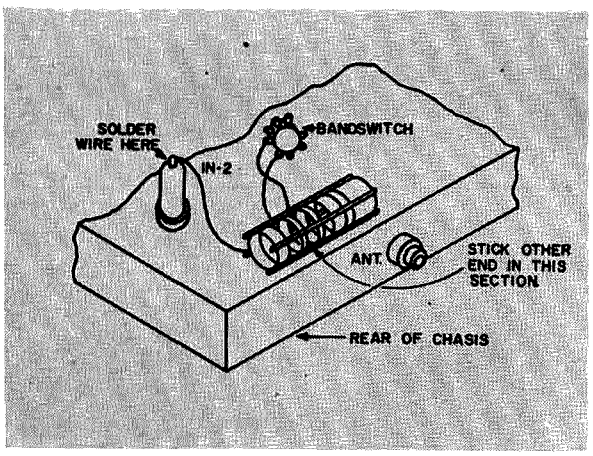
50 watts on 50mc in 50 seconds

Glen E. Zook K9STH
1006 W 16th
La Porte, Indiana

YOU don't believe it can be done, do you. Well, it can! All you need is a Heathkit DX-20, a small soldering iron or gun, a length of solder, and a piece of bell wire six inches long.

The DX-20 is a common low-powered rig found in many Novice (and even General) shacks. It, and its newer version, the HX-11, cover 80M through 10M. The oscillator is a 6CL6, and the final is a 6DQ6. On 80-15 meters the final operates straight through. On 10M the oscillator doubles a 7 mc rock to 14 mc, and the final doubles this to 28 mc.

Because the oscillator operates on 14 mc when the rig is on 10M, I decided not to use this position. I decided to use the 15M position in which the final is driven by the oscillator operating at 21 mc. I found that the oscillator tank circuit was broad enough to tune up to 27 mc, so I used it without modification. A little experimentation showed that if all but one and one half turns of the 15M final tank coil were shorted out, the 6DQ6 would double to six meters.



To make the modification, solder one end of the six inch piece of bell wire to standoff insulator IN2 (see pictorial 3 in manual and attached diagram). The other end of the wire is inserted two turns (at the top of the coil) from the second opening in the final tank coil (see diagram). This wire may be put in and out of the coil whenever you want to change from HF to VHF.

Operation on 6M is the same as on 10M. The bandswitch is placed in the 15M position, the grid current run at between 3 and 4 mils, and the plate dipped at 100 ma.

The transmitter may be returned to the lower bands by just simply pulling the wire from between the coils. This wire, when left soldered on the one end does not affect the operation on the lower bands.

My DX-20 is screen modulated (it runs about 35 watts) and does a very nice job on 6M. Presently I am using a lowly ground plane on six, and reports have been excellent. Best of luck on six, and hpe Cu Sn. ... K9STH

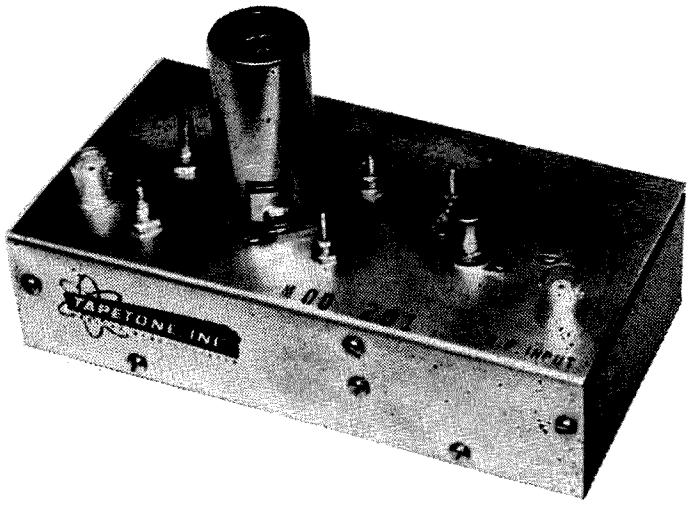
Replacement Auto Antenna has Amateur Application

Amateur equipment and antenna construction projects often require a telescoping whip type antenna. Inspection of available automotive antennas often fails to disclose one with suitable mounting characteristics.

A product that is suitable for many applications is the Ward Products Corporation Model TCFR-1 auto antenna replacement mast. This is a 3 section, telescopic antenna, measuring 57" extended. The antenna does not have a conventional insulator base. Instead, the bottom section of the antenna is drilled axially to accept a 5/16" stud and is provided with set screws to secure it in position. "Original Use" installation is accomplished by cutting off the broken antenna a few inches above the auto body, inserting the stub in the bottom of the replacement and tightening the set screws.

In amateur use, the replacement assembly may be used to extend existing antenna elements, secured to feedthrough insulator studs or fitted over ground-plane antenna casting studs. Coaxial connectors may be modified and a stud inserted to permit use with portable equipment.

Wholesaling for a little over a dollar, this replacement assembly provides a low cost answer to a common problem. ... W4WKM



REJECT

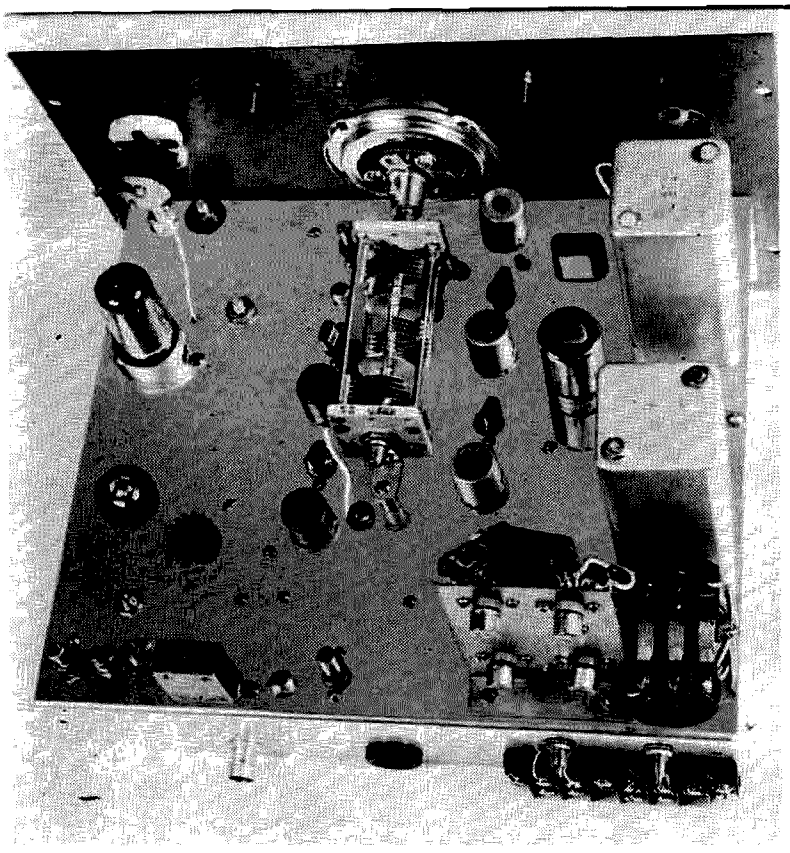
This model 201 was rejected. It had a noise figure of only 4 db. I doubt if you would have noticed it, but our final check technician sure did. Before a 201 6 meter converter leaves the plant, it must have a noise figure of less than 3 db and an overall gain of at least 22 db. In other words, a model 201 has to be twice as good as any competitor's best six meter converter or it is rejected. No coverter made for six meters has a lower noise figure, higher overload resistance, or more stability.

The model 201 is the absolute ultimate for 6 meters. The 201 is the most popular 6 meter converter made. And because it sells for only thirty-seven dollars and forty cents, anyone can afford to own the best. Input and output impedance is 50 ohms, and the **if** output is 14-18 mcs. If you must have the best on six see your local radio distributor, or order direct.

TE CO

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Transistorized 20 Meter SSB Exciter

Bob Smith W5FRC
Design Engineer
Texas Instruments, Inc.

Single sideband suppressed carrier type transmission is rapidly becoming very popular both commercially and with amateurs.

Since the generation of a single sideband signal is normally accomplished at low power levels, there are many advantages to be gained by the use of transistors. These advantages include smaller size, absence of filaments and ideal operation for mobile use from a twelve-volt storage battery. High quality signals can be achieved and all specifications on sideband suppression, carrier suppression, oscillator stability, and distortion products at the output can be obtained.

The exciter described in this article makes use of a Collins mechanical filter for desired sideband rejection. Carrier suppression and unwanted sideband suppression are equal to, or greater than, —50 db. The 300 mw RMS power output capability of this exciter is sufficient to drive a vacuum tube such as the 5763. Increasing the supply voltage on the rf stages to 24 volts will approximately double the available output power. A voice control (vox) circuit is included and an anti-vox circuit is used to prevent the exciter from being turned on by acoustical feedback.

One of the major problems encountered was that of VFO instability caused by the varying load presented by the mixer. This problem was eliminated by the use of a modified Hartley oscillator driving a buffer amplifier. The supply voltage of both of these stages is regulated to 8.2 volts by a reference diode. Oscillator frequency stability was found to be well within acceptable limits. (Less than ± 50 cycles after 1 hour of operation.) Linear operation of the output stages must be maintained in order to minimize signal distortion. This is accomplished by slightly forward biasing the rf driver and output transistors.

Although designed for 20 meter operation, the rf section can easily be modified for use on other amateur bands. Several contacts have been made using this exciter in conjunction with a 7 watt linear driving a 100 watt linear final. The 7 watt amplifier was mounted directly on the exciter chassis. Signal quality was reported to be excellent.

All transistors shown are available from Texas Instruments Incorporated Sales Offices and authorized distributors.

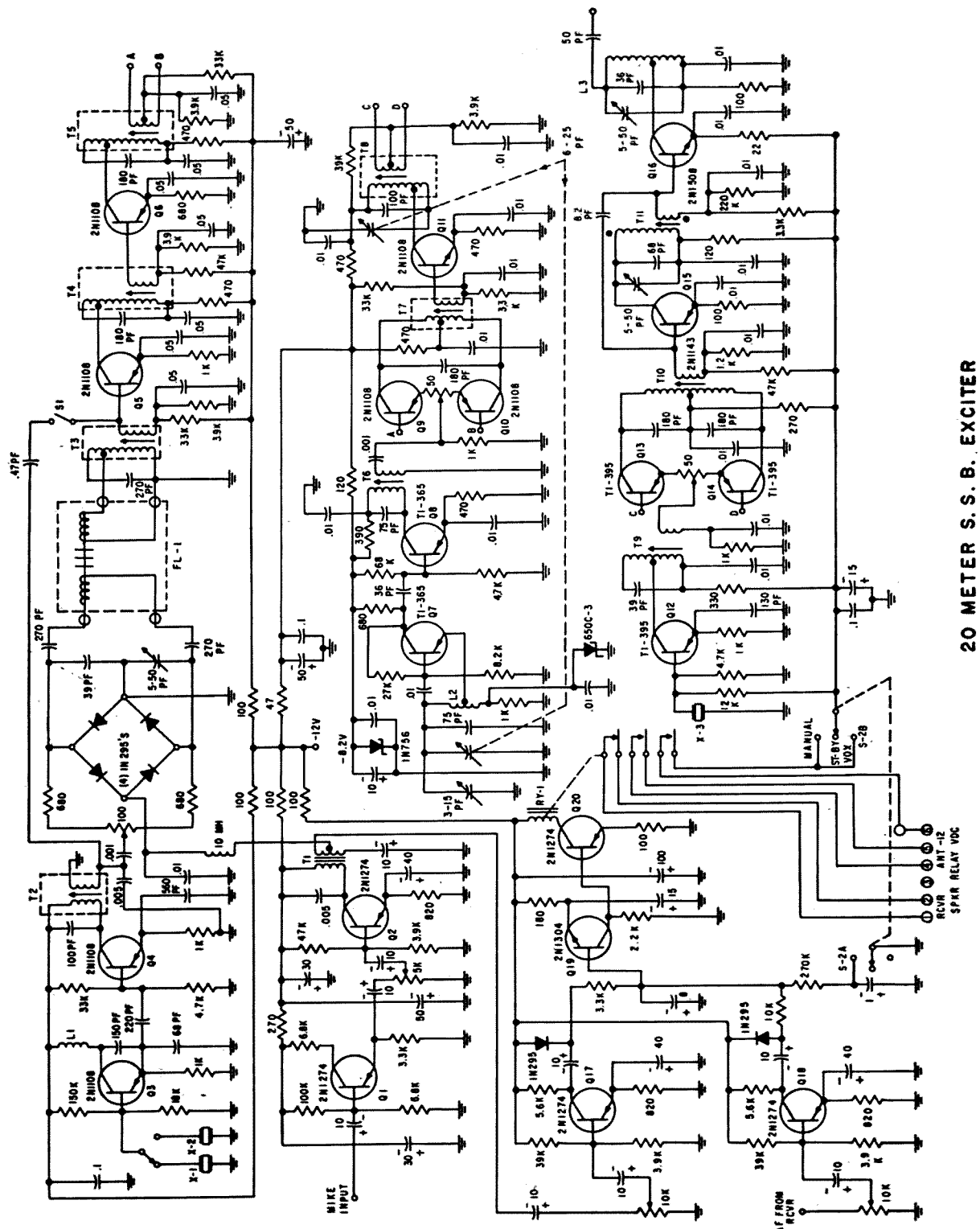
The audio amplifier, consisting of a common collector stage Q1, driving a common emitter amplifier Q2, is capable of delivering approximately 350 mv RMS to the balanced modulator. Frequency response is —3 db at 150 cycles and 3.5 kc. Power gain is approximately 30 db. The common collector stage presents a high input impedance for microphone operation.

The BFO, Q3, is a crystal controlled oscillator operating on either 453.5 kc or 456.5 kc, depending on the sideband desired. The buffer stage, Q4, amplifies this signal and is matched into the balanced modulator through T2. Approximately 1v RMS is delivered to the balanced modulator.

A set of four 1N295 diodes was matched for equal forward voltage drop at 4ma to insure proper balance. Additional balance control is provided by a 100 ohm potentiometer and a 50 pf variable condenser. A portion of the BFO signal is switched to the base of the first 455 kc *if* amplifier, eliminating the neces-

NOTES:

1. ALL RESISTOR VALUES IN OHMS
2. ALL CAPACITOR VALUES IN MFD'S EXCEPT WHERE SPECIFIED OTHERWISE. ELECTROLYTICS ARE USED WHERE POLARITY IS SHOWN.
3. CRYSTAL FREQUENCIES:
   X-1 453.5 KC
   X-2 456.5 KC
   X-3 17.1 MC
4. SWITCHES
   S-1 CARRIER INSERTION SWITCH
   S-2 FUNCTION SWITCH
5. FL-1 MECHANICAL FILTER COLLINS-F455J-31
6. RY-1 POTTER BRUMFIELD TYPE ML
   2 FORM A CONTACTS
   1 FORM B CONTACT
   DC RESISTANCE 300Ω



20 METER S. S. B. EXCITER



sity of unbalancing the modulator each time the rf output stages are tuned.

Sideband Suppression Filter and 455 kc if Amplifier

The output of the balanced modulator is a double sideband suppressed carrier signal and is fed into a Collins mechanical filter, type F455J31, where the unwanted sideband is virtually eliminated. This signal is transformer coupled into the 455 kc *if* Amplifier consisting of Q5 and Q6. The combined power gain of the mechanical filter and the 455 kc amplifiers is approximately 34 db.

VFO

The VFO consists of an oscillator, Q7, and an isolating buffer amplifier, Q8. Frequency range is from 3200 kc to 3460 kc.

First Balanced Mixer and Amplifier

Q9 and Q10 comprise a balanced mixer into which is fed the 0.1 v RMS output from the 455 kc *if* Amplifier and 1v RMS VFO signal from the buffer. The output of the balanced mixer is tuned to a center frequency of 2875 kc with a 3 db band width of approximately 100 kc. This signal is fed into a tuned amplifier, Q11, having a center frequency of 2875 kc and a 3 db bandwidth of approximately 50 kc. The tuning of this stage is tracked with the VFO to maintain a difference frequency of 455 kc. The combined power gain of the balanced mixer and amplifier is approximately 36 db.

High Frequency Crystal Oscillator

Q12 is used in a conventional crystal oscillator circuit as the master oscillator for the transmitter.

Second Balanced Mixer

The second balanced mixer consists of Q13 and Q14 operating in push pull circuitry The output of Q11 is transformer coupled through T8 into the bases of Q13 and Q14, between which approximately 1v RMS is present. Oscillator injection from Q12 is approximately 3v RMS at the arm of the balance potentiometer.

High Frequency Driver and Output

The output of the 2nd balanced mixer has now been translated to a 20 meter single sideband suppressed carrier signal. This signal is fed into a neutralized driver amplifier Q15 and an output stage Q16. Available power at the collector of Q16 is approximately 300 mw.

Vox and Anti-Vox Circuits

A portion of the audio output signal from Q2 is fed into vox amplifier Q17. This signal is amplified and rectified and fed into a dc coupled relay amplifier consisting of Q19 and Q20. Anti-vox amplifier Q18 receives its signal from the audio portion of the receiver. Its output is likewise rectified and fed into the dc coupled relay amplifier. Adjustment of the vox and anti-vox input level controls assure proper operation of the vox relay. Operation of these circuits can be defeated by switching to "standby" or "manual" operation.

. . . W5FRC

TRANSFORMER DATA

T1—Audio Output 10K:600 ohms CT, 300Mw
T2—455 KC Buffer Amplifier 20K:600 ohms
QU = 100, QL = 50
T3—Mechanical Filter Output to 455 KC IF Amp. 50K:2K
QU = 100, QL = 50
T4—455KC IF interstage 16K:2K
QU = 100, QL = 50
T5—455KC IF output to first balanced mixer
16K:4KCT
QU = 100, QL = 50
T6—VFO buffer amplifier output 10K:1K
QU = 50, QL = 10
T7—First balanced mixer output 40K CT:4K
QU = 50, QL = 35
T8—Low frequency amplifier output 10K:2K
QU = 75, QL = 50
T9—High frequency crystal oscillator
Primary: 14 turns #25 wire close wound
Secondary: 3 turns
Coil form: 9/32" diameter
Core: Powdered Iron
Arnold Type E material #A1-01
T10—Second Balanced mixer output
Primary: 14 turns #25 wire close wound
Secondary: 4 turns
Coilform: 9/32" diameter
Core: Powdered Iron
Arnold Type E material #A1-01
T11—RF driver output
Primary: 16 turns air dux #416
Secondary: 2 turns

Coil Data

L1—BFO buffer and amplifier collector coil 3mh choke
L2—VFO coil 62 turns #30 wire tapped at 20 turns wound on molded powdered iron form Quality Components, Inc. #QS-7-187-QU = 70
L3—RF Output Collector coil
16 turns air dux #416

Practical Uses for

Four Layer Semi-Conductors

Fred Cupp K8AOE
3810 East 365 Street
Willoughby, Ohio

THE "information" type article on four layer devices in the May 1962 issue of 73 Magazine delved at length into the theory of operation of four layer diodes with particular emphasis on the "SCR" type. An interesting relative of the SCR is the Shockley Diode (footnote 1). The article wound up by asking where some of these unique properties might be used, and it is the intent of this article to explore the practical applications of these new devices in answer to K4CPR's final question

The Shockley Diode, which is my particular favorite, is a two terminal device, unlike the three terminal SCR. Fig. 1 shows the two-transistor analogy of the externally gated SCR as compared to the same analogy for the Shockley Diode. The two terminal diode can be compared to the conventional SCR but with a Zener diode connected between the anode and gate terminals such that if the voltage is gradually increased across the device a point will be reached where the Zener diode will conduct and thus apply a trigger to the gate. This firing point will always occur at the same voltage, so we now have a voltage triggered four layer diode. Despite the apparent complexity of its operation, the Shockley Diode comes in a glass sealed unit of the same size as the miniature glass 1N34 diodes. Also don't let the small size fool you . . . the diode is capable of peak currents on the order of *ten amperes!* If you wish to delve further into the theory behind its operation go back and look up the article in the May issue. The theory explanations are essentially the same with the exception of the voltage sensitivity.

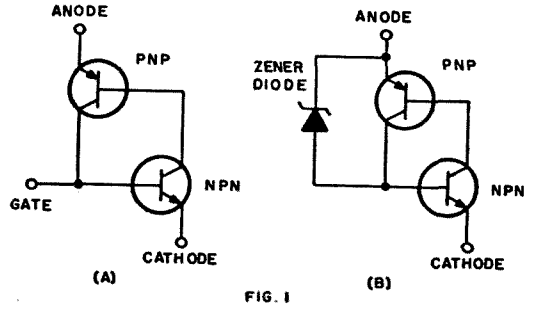


FIG. 1

Now that we know how the little gem works, let's get down to brass tacks. Fig. 2 illustrates the simplest use for the four layer diode. This circuit will perform very nicely as a sweep generator for a home brew scope.

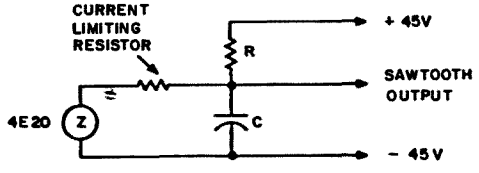


FIG. 2

The author has used this very circuit, and the re-trace time is so short that I found it unnecessary to blank the scope since the CRT wouldn't even register the trace. In case you're interested the firing time is around 50 nano seconds. The holding current for the type 4E20 diode is approximately 3 ma so with the voltage shown the minimum value for R should be greater than 15 K. Values between 22 K and 470 K may be used. The value of C is of course determined by the sweep rate

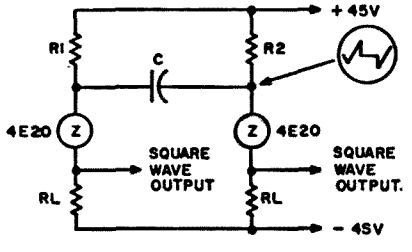


FIG 3

you desire. Since the diode is only good for 10 amps, it is necessary to provide a series resistor to limit the current to a safe value. A ten ohm resistor is sufficient and will not alter the operation at all. For greater linearity, if



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The HAM-M performs, consistently, in temperatures that range from −35° F to +140° F, under heavy antenna loading, through ice storms and hurricane-force winds. The HAM-M is safe—there is no voltage in excess of 24 volts in the rotor or control cable, and the control box is both fused and overload-protected.

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At $119.50 amateur net, the HAM-M is the greatest rotor value around! For technical information, contact Bill Ashby K2TKN. Your local CDE Radiart Distributor has the HAM-M in stock.

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used for a sweep generator, a higher supply voltage may be used, but again the resistance must be raised accordingly to stay below the holding current. If R is made variable, a resistor of the correct value should be placed in series with the pot to limit the current below the holding value.

Going on to the more exotic circuits, Fig. 3 shows the four layer diodes used in a free running multivibrator. In this case the anode resistance (R1, R2) must be lower in value so that whichever side is conducting will "hold" or remain on. The anode of the non-conducting diode will rise toward the supply voltage as C charges through the anode resistance. When the firing voltage is reached the diode conducts and the anode voltage drops sharply. This drop in voltage is coupled through the capacitor C, thus driving the voltage of the other diode's anode negative. This stops the current flow through this diode and the anode begins re-charging toward the supply voltage. The process is repeated with first one side conducting and then the other. A small value of resistance may be inserted in the cathode leads of each diode, and the voltage across these resistors will be a low amplitude square wave. These resistors are designated RL in the diagram.

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". . . the brain child of Dr. Robert Mellen and Carl Milner plus the production know-how of Cush Craft now presents this new VHF-UHF antenna. This new clover leaf antenna gives fantastic performance: omni-directional, it has horizontal polarization and extremely low Q. This results in improved band width, ease of matching and large "capture area." Dual stacked, Big Wheel gain figures (in all directions) compare favorably with the 7 element Yogi in its favored direction.

Pattern: 360 horizontal, variations of ± 2DB or less
Band Width: SWR 1 : 1.2 or less over 4 Mc
Gain: Single boy — approx. DB over Halo

PRICES

¾	meter	Model No. ABW	—	420	— $ 8.95
1¼	meter	Model No. ABW	—	220	— $10.95
2	meter	Model No. ABW	—	144	— $12.95

For Further Information & Illustrations Refer to:
Page 42 September QST and Page 60 October QST

Cush Craft 621 Hayward Street Manchester, N. H.

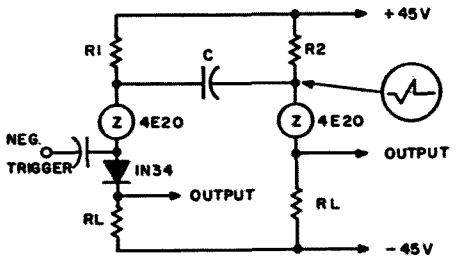


FIG 4

Until this time, we have been talking about 20 volt diodes, as indicated by the designation 4E20. By changing one of the diodes to a higher voltage such as a 50 volt 4E50, the multivibrator will always stop, or hold, with the low voltage diode conducting. The schematic for such a "one-shot" is shown in Fig. 4. A 1N34 diode is placed in series with the cathode of the four layer diode so that a negative trigger may be applied to the cathode.

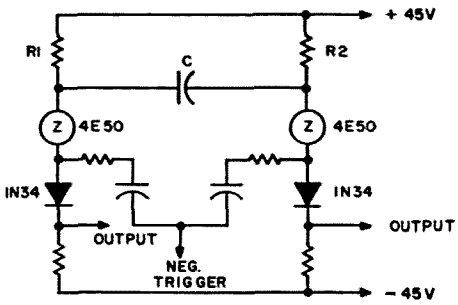


FIG. 5

Since the voltage across the 4E50 is already 45 volts, a negative trigger of slightly more than five volts will cause the total voltage to exceed the firing potential, and the diode will conduct, turning off the 4E20 diode. When C has charged up to plus 20 volts the 4E20 will again conduct, once again turning off the 4E50. Thus one square wave output pulse will be generated for each trigger applied to the input.

Figs. 5 and 6 illustrate two variations of the Bi-stable or Eccles-Jordan flip-flop. In Fig. 5, neither diode has sufficient supply voltage to trigger itself. When a negative trigger is applied, one or the other of the diodes will conduct. A second trigger applied to the input will cause the conditions to reverse. Although the trigger is applied to both diodes, since one is already conducting the trigger will do nothing to that side. The cathode of the conducting side is very low, so the trigger is dissipated across the resistor in series with the trigger line. The cathode impedance of the other diode is very high, so the trigger will show up on the cathode causing that side to fire.

By reversing the respective positions (but not the polarity) of one 4E50 and its 1N34, the polarity of the trigger required to operate the flip-flop is reversed. That is, a negative trigger will "fire" the left hand diode, while a positive trigger will "fire" the right side. Fig. 6 shows this type of multivibrator, which will flip to one state on the first negative pulse and remain in that state, ignoring all following negative pulses until a positive pulse is applied. It will then ignore succeeding positive pulses until reset by a negative pulse. Frankly I haven't thought of a use for this circuit yet but it sure is interesting to watch on a scope.

Now let's have a look at a circuit which can be used specifically by hams. Although there have been many designs published for automatic keys or "bugs" here is one more to add to the pile. This bug does not have a "memory" but it is self completing for both dots and dashes as well as holding off for the space. Fig. 7 shows the complete schematic for the bug. This is not just a "paper design," it has been completed and works very well. The reason there is no picture is that the breadboard model is still the only model and a picture would only serve to reveal my sloppy wiring technique. The left hand portion of the keyer may be recognized as the sawtooth relaxation

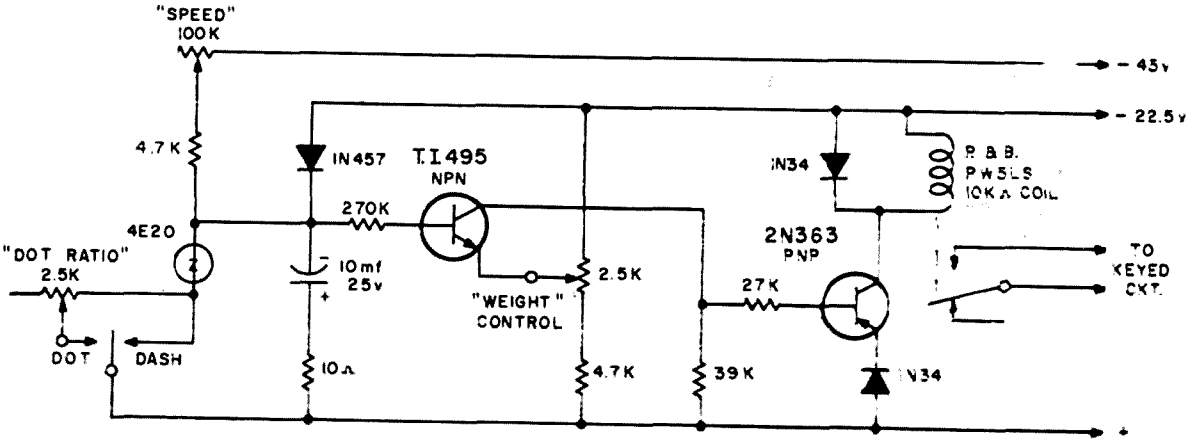


FIG 7

oscillator of Fig. 2. The only difference is that the polarity of all the components has been reversed. Since the diodes are two terminal devices, we can take the output from either the cathode or anode. In this case I chose to light the other end since it reverses the polarity of the sawtooth to go directly into the NPN transistor. The "Dot Ratio" pot changes the holding current or point, causing the diode to stop conducting before all of the voltage has been removed from the storage capacitor. In

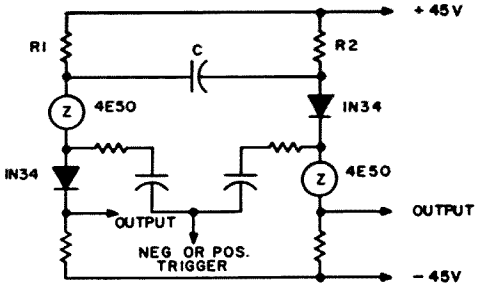


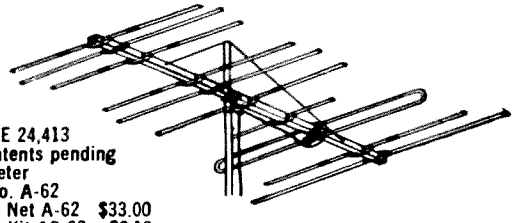
FIG. 6

this manner two different sawtooth frequencies are available depending on which contact of the key is closed. The dot frequency is adjusted to be twice that of the dash. Changing the "speed" control will now vary the rate of both the dot and dash together. The operation of the dc amplifiers is quite conventional except to note that complementary transistors (one NPN, one PNP) are used. The weight control sets the level on the emitter of the T.I.495 thus determining at what point on the sawtooth wave the relay will be operated. The theory of operation and the adjustment procedure is very similar to the speed key in the 1962 ARRL handbook, page 251. Other relays may be used of course, but take care to stay within the current and voltage rating of the 2N363 transistor. If you're a real speed demon you could use a high power transistor instead of the relay and key the transmitter directly. Several transistor keying circuits have been published in other magazines.

Last but not least, here is a four layer diode terminal unit for the RTTY set. Fig. 8 shows how easy it will be for me to get on RTTY when I can find a machine. (I'm still looking.) At the present time I must admit that all I've been able to do is watch the polar relay clatter back and forth and light two pilot lights to represent mark and space. Again this unit has been breadboarded and works fine on the bench. If someone actually tries it, let me know how it works out.

The beauty of this circuit is that no discriminator as such is needed. The 500 ohm output of the receiver is fed first to a pair of

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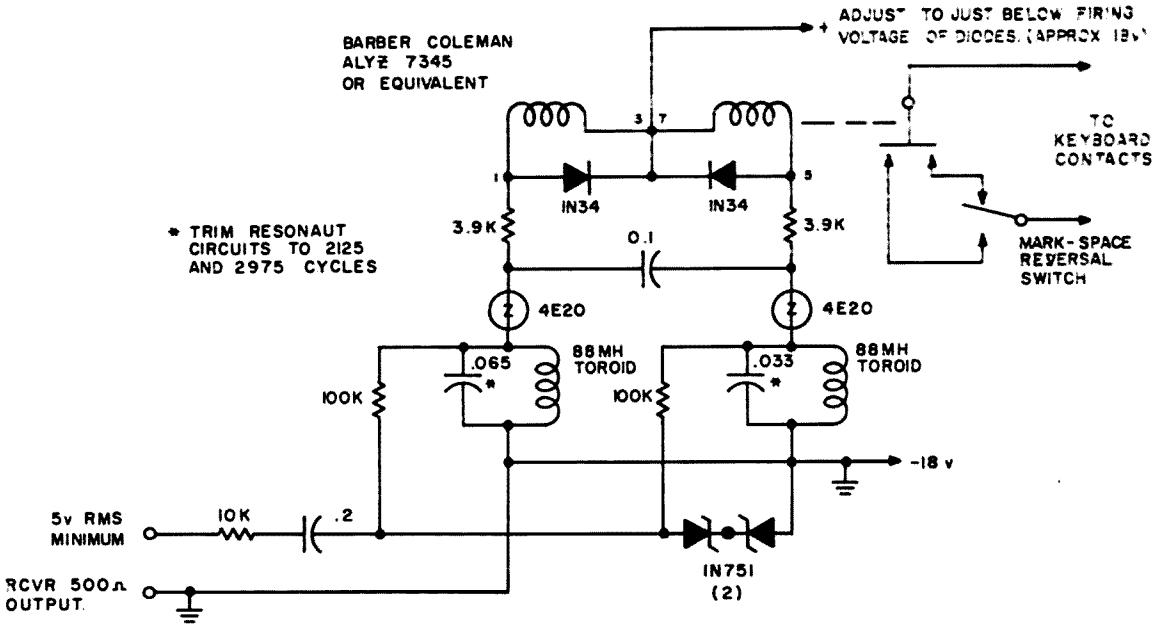


FIG 8

1N751 Zener diodes for amplitude limiting. It is then applied to the two tone filters through 100 K resistors. When the tone voltage swings negative the four layer diode in series with that particular filter will fire, drawing current through both the tone filter and the polar relay or micropositioner. Of course this will swamp out the tone in that filter, but so what . . . it's already fired that side. When a tone is received to excite the other side, the other diode fires, coupling a negative pulse through the .1 mfd capacitor turning off the first side. In this manner the relay will be latched in whichever position corresponds to the tone being received. Other relays may be used, or even two separate relays, or better yet one relay and only a resistor in the other leg to provide the holding current. As you can see, the variations to this idea are endless as long as you stay within the holding current of the diodes.

So there you have it . . . the total of my efforts to increase the popularity of the Shockley diode. Let's see what other uses some of you readers can come up with for it. Now I wonder why the Oscar Association used all those big bulky transistors in their keyer unit instead of four layer diodes? Hmmmmm . . . we could start off with a relaxation clock generator, followed by some Bi-stable flip-flops to divide them. . . .

. . . K8AOE

Footnote 1. Shockley Division of Clevite Corp., Palo Alto., Calif. (Send for their folder of application notes. It's free and makes interesting reading). You won't be able to get them from your local parts distributor. They are in stock at Semiconductor Specialists, 5706 W. North Ave., Chicago 39, Ill. Try any large industrial supplier such as Allied Radio Industrial Dept., $3.30 ea. in small lots.

Improved Base Clipper

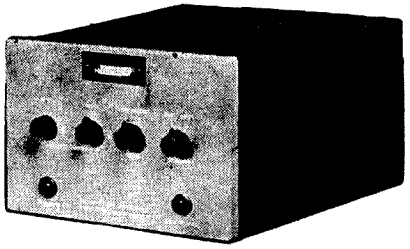
"Cleaning up" of messy received signals, both CW and phone, by use of a base clipper, is a technique which is known apparently to only a few amateur and commercial operators. By use of a base clipper, also known as a zero limiter, and a trough limiter, all signals below a given adjustable amplitude are eliminated, and all signals above this amplitude passed. The signal amplitude is reduced by the clipping level, but the signal to noise ratio is, or can be, very greatly improved.

Although the Earle "A. C. Threshold" circuit[1], one of the first base clippers described in open literature, is an excellent performer, it requires quite a few components, and does not permit effective isolation of the audio circuits from the power supply. The much simpler series-controlled base clipper[2], performs the same functions, but has a control that is "hot" to ground, and no definite "off" position.

A similarly-functioning circuit, in which the control is at low potential with respect to B+, and "dead" with respect to af, is shown in Fig. 1. A definite "off" position is provided by means of a switch in the B+ line which pro-

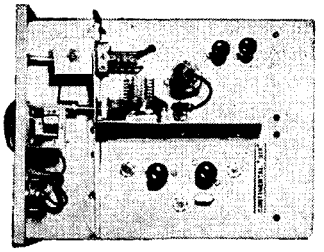
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vides back bias for the diodes. When the "CLIP LEVEL" control is set to zero resistance, there is no back bias on the diodes, and incoming signals are passed on to the output substantially unchanged (except for a negligible "toe" effect in the diodes). When, however, the "CLIP LEVEL" is set at some value other than zero, a back bias is applied to each diode, and all parts of the incoming signal below this value are blocked, and do not reach the output.

Under ordinary conditions, the base clipper is installed in a receiver after the crash noise limiter. If installed before it, the base clipper can well be a noise accentuator. With constants shown, maximum clip level is at 6.5 volts, which will eliminate most or all of most detector outputs. Maximum clip level can be raised by increasing the infeed voltage, or by increasing the 10K resistors to a higher value. Maximum clip level can be reduced, if desired, by lowering the infeed voltage, or by lowering the value of the 10K resistors.

When the base clipper is not needed for a considerable period of time it can be shut off by turning the "CLIP LEVEL" control past zero, opening the integral switch.

In operation, the signal is tuned in with the base clipper turned to a low level, or off. If the signal is messed up by background noises, the base clip level is advanced slowly until maximum intelligibility is attained. This will be near the peak level of the unwanted background noise, but seldom exactly at it. As we are interested in maximum readability, the operator's ear, and not some formula or some meter reading, is the guide to correct adjustment.

Life of this base clipper is problematical, but long. One built in early 1959, and in almost continual use since, is still working perfectly, and has needed no servicing.

Ronald L. Ives

References:

(1) Earle, W. A. "A-C Threshold Converts to Switch," Electronics, Vol. 31, No. 1, Jan. 3, 1958, 98-100;

(2) 73 Staff, "Stop That Noise," 73, Vol. 1, No. 2, Nov. 1960, 24.

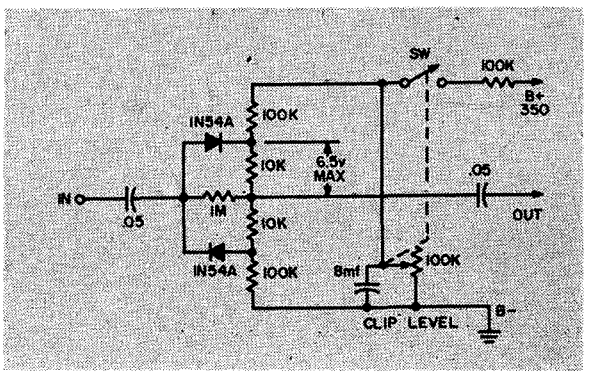


Fig. 1. Improved base clipper.

De-Chirping a VFO

or

Chirp from a surprising source

Harold Carlson K7MSL
Carpenter, Wyoming

FOR many years I was involved in research and development of tuning fork oscillators of high precision. They were designed to a deviation specification of ± 5 parts per million, without temperature control. This accuracy is now maintained, day in and day out, month to month, over wide temperature changes. Of major interest was the fact that mechanical design of the entire assembly was a large factor in the oscillator's stability.

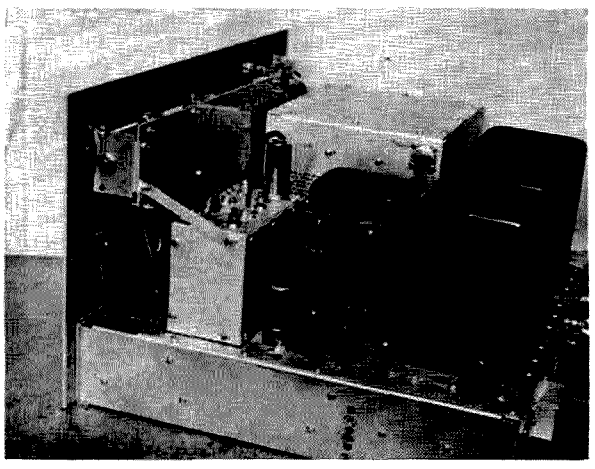
If there is any doubt the mechanics involved in a radio frequency oscillator are a factor in frequency stability, one needs only to loosen or tighten screws in the oscillator, or remove a shield cover, to be convinced. Here's what this is leading up to:

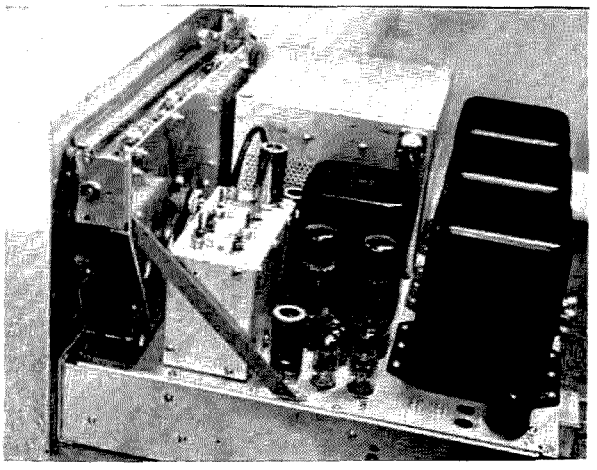
During the last several months I had a great deal of trouble with a kit VFO. It would be stable as a rock one day, and key cleanly, then chirp like a meadow lark the next. Many times I thought I had found the gremlin and eliminated it, only to learn a few days, or weeks later, that I hadn't. My first suspicion was a bad capacitor, and I changed them one at a time in order to determine the faulty component. Each time I changed one, and put the VFO back together, the chirp was gone, and I thought that was it, for a few days.

Noting that exerting any force on the band switch knob affected the frequency slightly, and sometimes caused a chirp, I suspected the band switch. Rapidly switching from band to band would sometimes eliminate the chirp for a while. So, I changed the band switch—and the chirp was gone—for about a week.

Once when the rig was on the lab bench, it was noticed that the key jack had a cracked spring. Feeling a bit foolish, I changed the jack, put the VFO back together without changing anything else—and the chirp was gone. About two weeks later the little canary was back again. The trouble was intermittent, and the tendency was to leave the rig in service until the trouble became persistent enough to locate. But I like to have a clean signal, and took the VFO apart once more, this time with the determination that it would be fixed, or R.I.P.

Now the VFO is fixed, and the cause of the trouble was determined. It is so fundamental in design consideration that it may be a fault in other kits of this type. The fault proved to be mechanical. A brace from the front sub panel to the top of the VFO housing was the culprit. This is why every time I took the VFO apart and changed a component it usually didn't chirp again for a while. I merely had relieved the mechanical stresses being





transmitted to the top of the VFO housing. The brace was a good mechanical coupling to the panel on which the spring loaded frequency dial roller was mounted. This exerted varying stresses on the panel, and transmitted them efficiently to the VFO. This unstable stress condition caused critical frequency stability, and chirps.

The brace referred to is shown in Fig. 1. Removing the screw "A," and bending the brace back out of the way was all that was needed to give the VFO stability, free from chirp, or frequency shift.

With the many years of background that put me in contact with this basic design concept, I was thoroughly ashamed for not having suspected the cause earlier.

Since removal of the brace made the front sub panel a bit wobbly, a longer one was made. A hole was drilled in the chassis plate, and the brace attached at the lower end with a sheet metal screw. This is a change I would recommend to all those who have this, or similar, unit and are having trouble. Fig. 2 shows the new brace in position. It was made of ½" wide 3/32" stainless steel, that I happened to have in the junk box. Aluminum would do as well, and be easier to work.

Recently, I put the old brace back for a check. You guessed it—chirp! Now it is gone to stay, and I'll not forget that mechanical design is important around a VFO.

As a bonus, I learned that substitution of *molded* silvered micas for the *dipped* micas in the VFO gave noticeably cleaner keying and better frequency stability. The reason hasn't been determined, but you might like to try it.

Letters

Dear Sir,

Reference the article on Selected Circuits by W4WKM on page 46 of the June issue of 73. As shown the VOX assembly will not work. The 200 volts, pin 4, input is shorted to the ground at the cathode, pin 3, of V18. The 200 volt line should cross the ground line and connect to the 3.3 K resistor R167. Good articles, keep 'em coming.

Ken Mulkey WϕVPH/4

Dear Wayne:

I wish you would get rid of this guy Gridley K6JHJ. A couple of months ago I bought some 85kc. if trans. and was wondering what they would do in a back to back hookup. Then here he comes along with the same thing in his Q5-er.

After reading the article on the panadapter I got to thinking about building a sweep osc. using a diode to change freq. Now he comes along with the "New Broom." How can I learn anything with him always figuring these things out for me?

Andrew R. Becker WϕNVM/KGI

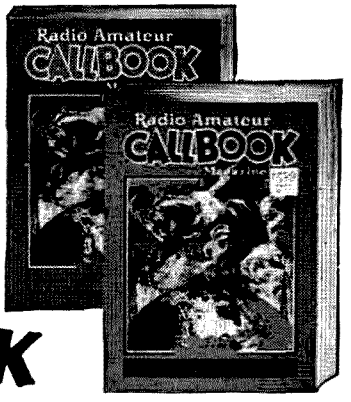


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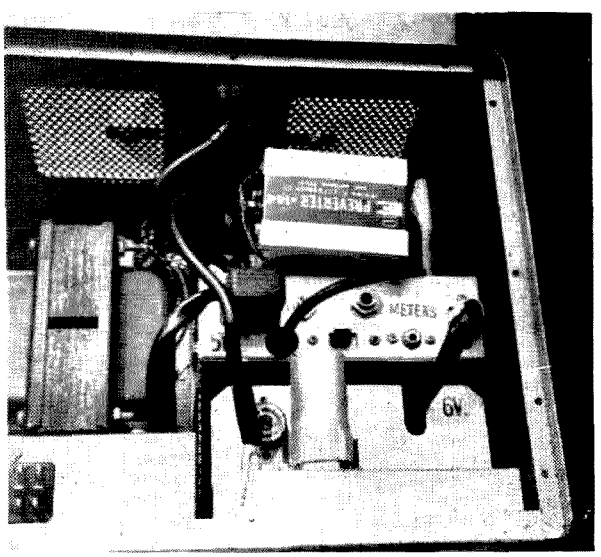
73 tries out the

Irving Electronics Preverter

Irving Electronics has quietly been building up a collection of printed circuit boards and small kits which come as quite a surprise to the fellow who happens to notice the small Irving ads and sends for a catalog. Pappy, W5UB, has little printed circuit kits for almost every article printed in a ham magazine (including 73) where a circuit board is specified or where a circuit board would prove beneficial. He has a lot of other kits too. His most recent gadget is a completed unit, something new for Pappy, a little two meter or six meter transistorized preamplifier.

This $14.95 (postpaid) Preverter, as he calls it, operates entirely from twelve volts. This makes it very handy for mobile installations as well as remote applications such as installation at the antenna as a booster to make up for feedline losses. We sent for the two meter model and found that it was small enough to cram into the back of the Gonset II transceiver. It is 2¾" x 2⅛" x 1⅝". The Gonset is easily modified for this preamplifier.

The installation took only a few minutes. The antenna coax is removed from the receiver and run through the Preverter (this requires a connector change). The 12 volts for the Preverter was borrowed from the Gonset B+ line



via a dropping resistor. A 9 volt battery was tried and worked just as well. The results were a pleasure, though they brought on difficulties. We found that now we coud hear many stations that didn't come through before and that we really needed a linear to boost our signal to keep up with the improved reception.

The Preverters, all wired and set to go, are available from better dealers or direct from Irving, Box 9222, San Antonio 4, Texas.

Letters

Wayne,

Now that 73 Magazine has been out for a year and a half, I thought I'd write to tell you how much I enjoy it. Thinking back over these past twenty-one months, some particular articles come to mind as being exceptionally good. These include W70E's literary works, ALL of your editorials, W2ZGU's How to be an Amateur, W2BNW's From My Side of the Counter, and your excellent technical articles. Talking of technical subjects, I hear that K2PMM is coming out with a shoebox VHF receiver with continuous tuning from 140 to 5000 megacycles, with 60 db gain on 140 megacycles, 40 db gain on 5000 megacycles, and better than a 3.5 noise figure. Will it make the september issue?????

Morgan Spencer K5CHH

73 Magazine:

An enormous improvement in the 75S-1 receiver for A.M. is simply made by replacing T7 & T8 (278-0278-00) with comparable transformers from the 75S-3. These are T4 & T5 (278-0281-00) which cost $3.36 each from Collins—Two are needed.

You can check your 75S-1 by turning on the crystal calibrator, switch to AM, dial 7100 kc., adjust Preselector for S9 signal. Now see how wide your pass-band is by tuning each side of center to dip the S-meter one unit for each 6db. The new transformers will give:

6db	3.2 kc	old 4 kc
12db	4.2 kc	
18db	5.0 kc	
24db	5.8 kc	
60db	10.2 kc	old 20 kc

There is also a very worthwhile increase in gain and hence in the speech from the loudspeaker.

Edgar V. Seeler W1BDF

Dear Wayne,

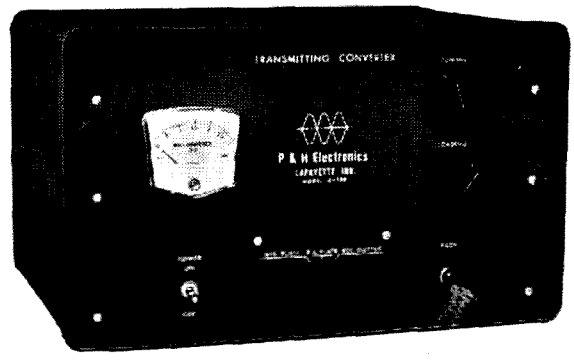
I will say that your magazine is more fun than the other two together. I feel that ham radio is for me, too, as well as for electrical engineers, space scientists and mathematical geniuses . . . you see, I am but an old bricklayer, 51 years, but when I strap on the phones I become ageless with the thrill of a DX QSO. This ham radio keeps a fellow busy learning, but is sure generous with her rewards. Thanks for a fine magazine, one which does not cater to one group exclusively.

How about a car emblem? Might be a snazzy looking "73" . . . something to extend a greeting to a fellow ham.

Ralph Knoblauch WV6VNF

Call letter license plates are doing the emblem job, I suspect, but if anyone would care to design something we might have it made up by one of the sports car emblem manufacturers and make it available. Any designers in the crowd? Wayne

the VHF TWINS



MODEL 6-150 SIX METER TRANSMITTING CONVERTER

Converts the 20 meter output of your SSB, AM or CW exciter to 6 meters. Power input to 8117 final; 175 watts PEP on SSB, 165 watts CW, 90 watts linear AM. Resistive pi-pad permits operation with any 10 to 100 watt output VFO or crystal controlled exciter. Meter reads; PA grid, PA plate, Relative output. 50-70 ohm input and output. Quiet forced air cooling. Modernistic, recessed panel cabinet 9" x 15" x 10½".

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***Slightly higher West of Rockies**

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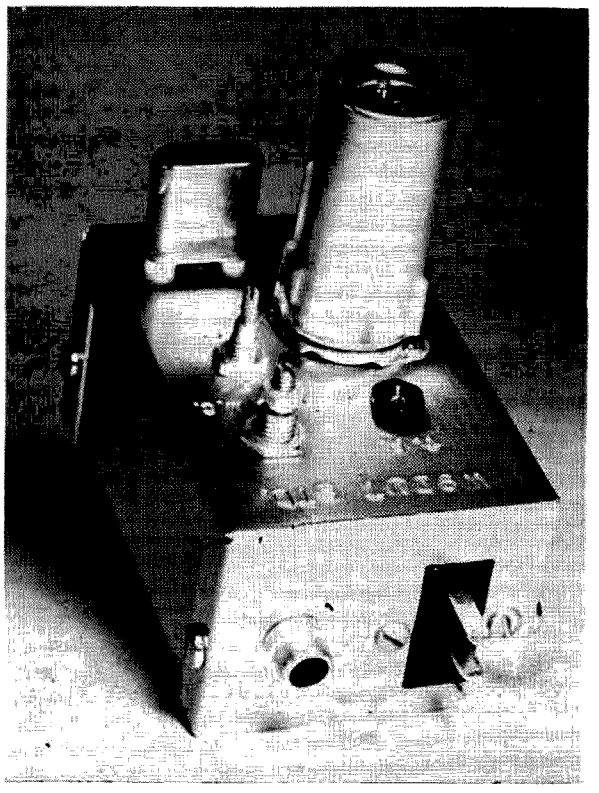
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FREQUENCY calibration is very important especially when operating near the edge of the band. It is equally important for accurate setting of the dial in an all band communication receiver used as a tunable *if* strip in conjunction with a crystal controlled converter in the VHF bands. Receivers used in such applications, even if they are calibrated accurately on the lower bands, do not give assurance that the dial is right on the spot due to crystal tolerance in the converter oscillator. Therefore, to be sure, the calibration should be made at the VHF frequency with a known crystal oscillator or generated harmonics which are a multiple of the time signals transmitted by WWV.

Most receivers used with converters are commercial communication receivers with built-in beat frequency oscillator and zero beating with proper frequency standards is rather simple. But a large number of hearing-aids that are also used in this mode of operation do not have BFO's and locating unmodulated signals becomes a problem. To overcome these disturbing obstacles, the little gimmick monickered TMCS was developed, and here is what it will do for you:



Produce signals every one megacycle from 1 mc up to 225 mc and a bit beyond.

Tone modulated signals that can be received on all receivers including those that have no BFO.

The fundamental crystal can be adjusted to zero beat with WWV.

One tube arrangement which means inexpensive and simple to build.

Circuit

The circuit is straight forward and simple. One half of the 6J6 is used as an ordinary crystal oscillator using fundamental crystal of one megacycle. This crystal is shunted by a variable capacitor of 35 mmfd (MAPC-35) and is used to set the crystal oscillator exactly on WWV frequency. The plate circuit of this triode is tuned to one megacycle and the rf energy is coupled through the 50 mmfd ceramic capacitor to the grid of the second triode. This half of the 6J6 is the harmonic generator that extends the one megacycle increments to over 225 mc. The plate of this harmonic generator is tuned to 150 mc, but this frequency is not critical. Any frequency of 100 to 150 mc may be used keeping in mind that the higher the resonant frequency of L2, the higher will be the upper limit of usable harmonics, but the harmonics between the one megacycle osc. and L2 will be somewhat weaker.

Tone modulation is obtained by the use of a relaxation oscillator, as shown on the schematic. By charging the .002 ceramic capacitor

C1 through the one meg. resistor R1 and discharging it through NE-2 neon bulb, a tone of about 2000 cycles is obtained, depending on the tolerance of the components in the associated circuit.

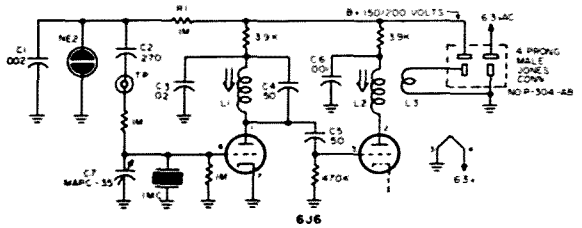
Before starting construction, a word of caution might be in order at this time in regards to the NE-2 glow tube. Some of these little fire flies may not function properly with the values given, due to larger spacing of glow elements in them. If you happen to get one of these just lower the value of the one meg. resistor and slightly increase the value of the .002 charging capacitor to maintain the same tone. Pitch is not too important in a device of this kind just so it is somewhat pleasant and the constructor may want to experiment with different combinations of RC values to suit his fancy.

Construction

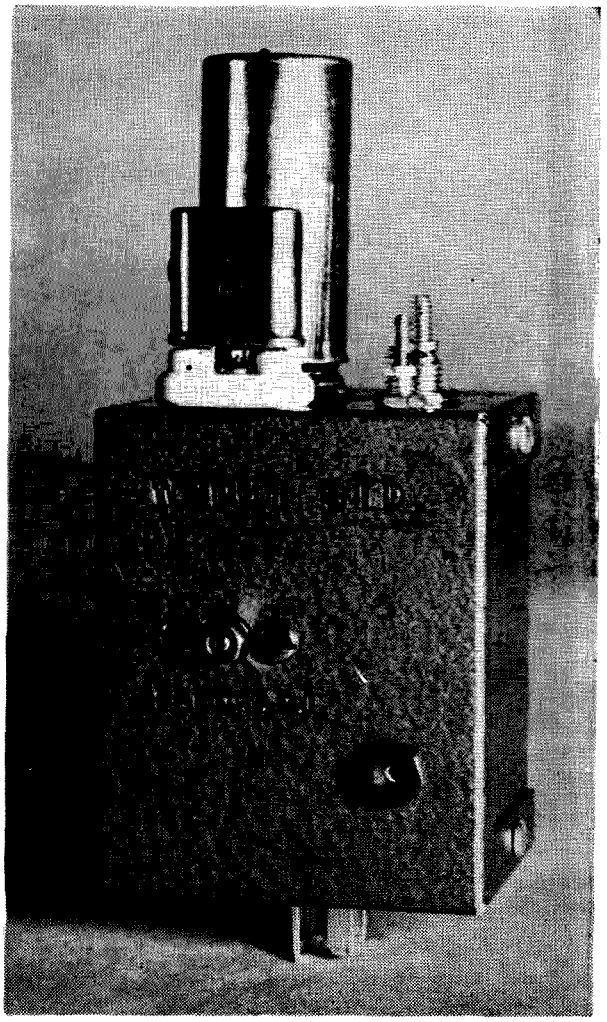
The unit can be built in two of the designs shown in the photos, but the preferred design is the vertical plug-in unit which seems to adapt itself a little better in most applications.

All parts used in this project are standard and can be obtained in most electronic stores over the counter. The only mechanical work required to put you in business is the punching and drilling of the mini box used as the enclosure for the small components as well as the necessary chassis. The parts lay-out is not important as long as they fit into the box, so a lay-out drawing is not necessary. However, identification of components is in the following order.

The front view shows the one megacycle crystal on the top side of the box. To its right is the one megacycle slug tuned coil, obtained from J. W. Miller Co., and carries a number 4313. Just behind this coil is L2 which is wound on J. W. Miller ceramic slug tuned form and tuned to 150 mc by the aid of a grid



C1 to C6—RMC discaps ceramic capacitors.
C7—Hammarlund MAPC-35.
All resistors ½ watt.
L1—Miller No. 4513 (190 to 330uh adjustable).
L2—4T #22 space wound to ¼" on Miller Ceramic coil form No. 42 A 000CBI (⅜" x 1").
L3—2T #26 plastic, close wound on cold end of L2.
Tip. Johnson nylon tip jack No. 105-251-1.
Mini Box—Bud CU2100-A 2¾" x 2⅛" x 1⅝".



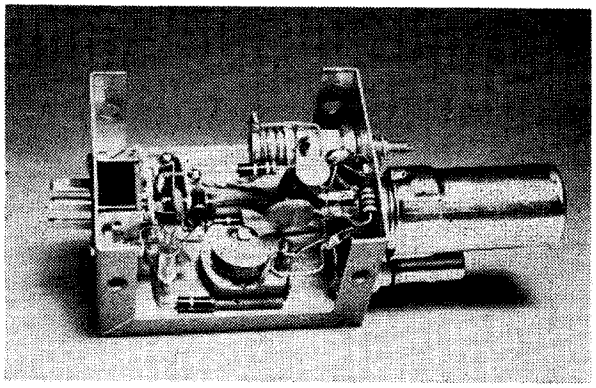
dipper. To the left of this coil is the dual triode 6J6 electron tube with its shield. Below the crystal is the Hammarlund MAPC 35 mmfd frequency adjusting capacitor. Just to its right is a test jack for checking the intensity of the oscillator and the tone modulator. The bottom of the unit has the 4 prong jones male connector for power input and modulated rf output. A separate shielded rf output connector can be used if so desired and an arrangement similar to the horizontal unit shown can be used.

The photo of the inside view shows the MAPC capacitor, to the left of it is the NE-2 relaxation oscillator bulb which is used to tone modulate the crystal standard. To the left and slightly above is the jones connector. The 150 mc multiplier coil can be seen in the upper right hand.

Calibrating and Application

The TMCS can be calibrated on any of the WWV time signal frequencies of 5-10-15-20 and 25 mc in the following manner.

Tune the communication receiver to WWV



and couple the output of the TMCS to the receiver's antenna. Zero beat the time signals with the crystal oscillator by rotating the MAPC capacitor until a slight null is recognized, denoting the center of the carrier. If difficulty is encountered in locating the null, the relaxation oscillator is too strong and should be slightly de-coupled by lowering the value of the 270 mmfd coupling capacitor. The value of this capacitor is chosen so that the tone modulation is strong enough to identify, but not strong enough to cause frequency shift.

Using the TMCS standard with crystal controlled converters, simply connect the rf output of the standard to the antenna input of the converter and tune the previously calibrated communication receiver in the proper section of the band used as the tunable *if*. The modulated signal you will hear every megacycle will appear to be off calibration on the receiver's dial. This degree of differential is caused by the % tolerance of the crystal used in the converter oscillator and is normal in general practice. However, knowing this discrepancy, proper correction can be made to the receiver's dial for accurate frequency spotting.

Now that you have calibrated your receiver and your converter, you are ready to commit yourself on the accuracy of interpreting the correct VHF frequencies.

. . . W9DUT

The Simplest Squelch

George Thurston W4MLE

73 has already provided its readers with a masterly survey of the subject of squelch circuits for receivers (73, Dec. 1960) but the article included two curious oversights.

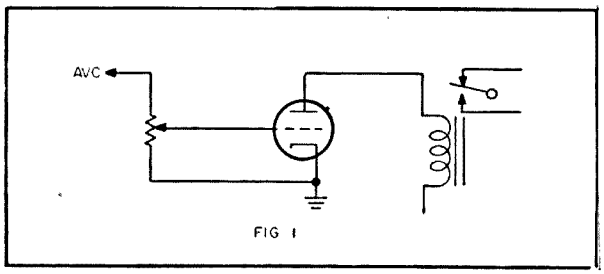


FIG 1

The circuit shown for the SCR-522 relay squelch (Fig. 1) will, it is true, degrade the receiver AVC operation because of the extra load resistor. However, a very simple modification of this circuit results in an equally simple circuit without any circuit degradation, and with full control of the squelch threshhold. (Fig. 2).

R-1 regulates the bias on the tube and hence the point at which the relay will just pull in. Any increase in this bias will further reduce plate current, causing the relay to drop out and the squelch to "open."

The other interesting oversight is that in the same issue, Roy Pafenberg had an interesting article on "The Multivibrator in Amateur Vox Circuitry." The only difference between Vox and Squelch is that the relay (or other circuits) operate different things. One turns on a transmitter, the other turns on a receiver. Put it in a transmitter, it's VOX. Put it in a receiver, it's squelch.

Every advantage Pafenberg claims for the Schmidt trigger for VOX operation is equally advantageous for squelch. The Schmidt trigger squelch should be especially helpful in areas where received signals are likely to be weak, and fading but where positive squelch action is desired. In noisy locations, this sensitivity to small changes in demodulator bias could be undesirable. But like all squelch circuits, the tripping level can be adjusted to suit any situation and the Schmidt could be set to trigger only on signals which exceed a pre-determined noise level.

. . . W4MLE

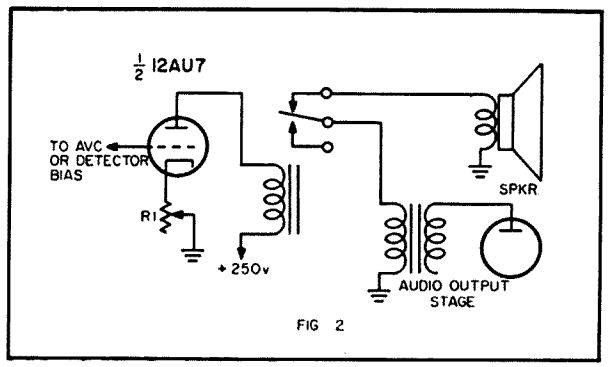


FIG 2

Transmitter Design

Jim Kyle K5JKX

IN an earlier technical article, we looked into the basic techniques of amplifier circuit design and showed how to put together a Class A amplifier in a matter of minutes.

But Class A amplifiers are primarily confined to audio and to receiver circuits; to make complete the design of a transmitter, we also have to come up with some Class C amplifier stages. The technique of Class C circuit design differs drastically from that for design of Class A stages, but is no more complicated.

Before going into the detailed procedure of design, let's take a look at the Class C amplifier and see how it works. A good starting point is the conventional Class A circuit.

In this circuit, the tube acts like a variable resistor; incoming signals change the resistance of the tube, and this change in resistance appears as a change of voltage across the tube's load resistor because the tube resistance and the load resistor are in series across the power supply. The simplified equivalent circuit is shown in Fig. 1.

Since the signal will suffer distortion if the tube's grid ever goes positive, the tube is "biased" with negative voltage on the grid to ensure that the incoming signal will never drive the grid into the positive region. This bias is chosen so as to make the tube's gain on positive-going half-cycles of input signal the same as the gain on negative-going half-cycles, or in other words, at a point so that equal changes in grid voltage on either side of the bias point will produce equal changes in plate voltage.

Such a circuit is linear, in that the output signal will be a faithful replica of the input signal although stronger. However, plate current must always flow in this circuit—and in the absence of an input signal, this plate current does nothing but heat the tube. For this and related reasons, the Class A amplifier cannot produce efficiency greater than about 50 percent. Half or more of the input power is wasted.

This waste of power is necessary to obtain linear operation; however, an rf power amplifier need not be linear. Any distortion introduced by the tube will be ironed out by the following tank circuits.

Maximum efficiency is obtained when current flows through the tube as a series of short pulses, with relatively long periods between pulses during which no current flows. Fortunately, the pulses which provide best efficiency are also best suited to driving a tank circuit, and a Class C amplifier is one which is set up to produce such pulses.

Such a circuit, in simplified form, acts like a resistor in series with a switch (Fig. 2). When the switch is closed, current flows through the resistor and is limited only by the value of the resistor and the voltage of the battery. When the switch is open, current flow is zero. Thus, the switch is like the variable resistor of the Class A amplifier, in that it controls the flow of current through the load resistor.

In practice, the tube of a Class C amplifier is made to act like a switch. When the tube grid is made so negative that plate current ceases to flow, the tube is electrically the same as an open switch. When the grid bias is reduced enough to allow a large flow of plate current, the tube is similar to a closed switch (plus a small resistor producing some voltage

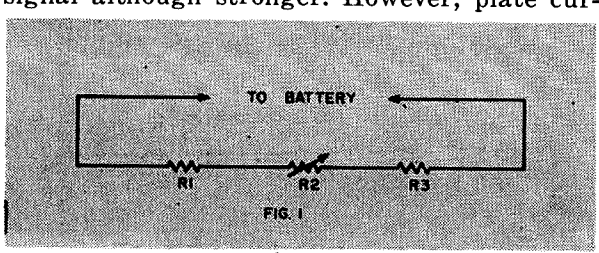


Fig. 1 Class A Circuit.

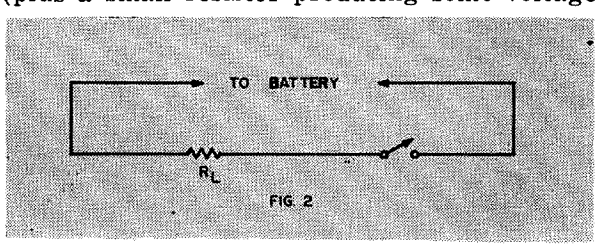


Fig. 2 Class C Circuit.

drop across the tube). Thus, by choosing the proper grid bias and signal input voltages, the tube may be made to operate only during short parts of the incoming signal cycle, and to rest the rest of the time.

A number of factors enter into the design of a Class C amplifier. These factors may be roughly classified into those which pertain to the type of tube used, and those which pertain to the parts of the circuit external to the tube. Let's examine the tube factors first.

Important tube factors include the plate voltage, the plate current, the screen voltage (if applicable), the grid bias, the power output, the allowable plate dissipation, and the amount of driving power required. These factors are all interrelated for any individual type of tube; Table I lists the key factors for a number of popular tube types. The factors for unlisted types may be obtained from the tube's characteristic curves and associated information.

You can see from the table how some of the interrelations work. For any specific screen voltage, for instance, a given voltage on the grid will allow a certain plate current. If either screen or grid voltage is made more positive while the other is kept constant, plate current will increase. At the same time, minimum plate voltage (the voltage across the tube in its closed-switch condition) will also increase. The power represented by this minimum plate voltage (which we'll call EB_{min} henceforth to save space) is wasted; the output power is determined by the voltage *swing* in the plate circuit, or the *difference* between the supply voltage and EB_{min} as listed in the table.

Since the minimum plate voltage remains constant for any given current, you can see that the swing (and as a result, the power output) will increase to a larger percentage of the input voltage and power as the power *supply* voltage is increased. For instance, 100 volts at 50 ma is the same amount of power as 1000 volts at 5 ma, and if these happen to be the supply voltage and plate current, respectively, of an rf amplifier you would have 5 watts plate input in either case. However, to get 50 ma of plate current you might have to accept a 60-volt value for EB_{min}, which would leave you a swing of only 40 volts in the plate circuit, or a power output of no more than 2 watts even if you could get 100 percent conversion efficiency. With a 1000-volt supply and the same EB_{min}, your swing would be 940 volts, producing a possible power output of 4.7 watts—more than double!

But that's not all. At 1000 volts, you need only 5 ma of plate current, and the value of EB_{min} to produce 5 ma is considerably lower than that necessary for 50 ma. A typical value would be about 25 volts—maybe less. This increases the swing to 1000—25 or 975 volts, allowing a possible 4.875 watts out.

In the preceding examples, we assumed that the output power was determined only by the voltage swing in the plate circuit and the value of plate current. This assumption is not quite true; additional losses are introduced in converting the more-or-less square plate-current pulse into a sine wave, so that the actual power output is only 86.4 percent of the maximum-output figures quoted above. However, the basic principle that high voltage and low current give more efficiency than do low voltage and high current, still remains true.

By this time, you can see that proper operation of a Class C amplifier depends primarily on picking the proper operating point for the tube you intend to use. You must choose the values of plate supply voltage, plate current, screen voltage if applicable, and grid bias. Then, you must determine the amount of power necessary to drive the stage; if a driving amplifier is needed, it must then be designed, and so forth back to the oscillator.

The conventional approach to such design involves several pages of calculation for each stage; however, if we restrict ourselves just a little bit in some of our choices, the procedure can be reduced to nothing more than graph-reading and a little bit of simple arithmetic.

The two most involved calculations of the conventional approach are those to determine output power and to determine the value of grid bias necessary. These calculations (for the power range 0 to 15 watts and for values of grid bias between 0 and 110 volts) are worked out in the graphs of Figs. 3 and 4, reducing the design technique to a series of simple steps.

The first step, naturally, is to pick the power level at which you want to operate. At the same time, pick the supply voltage you intend to use (this is usually fixed by the available power supply). Dividing the value of the voltage into the desired power will give you the amount of plate current (in amps, not ma) necessary. Three of your variables are now determined.

Next, pick a tube type capable of passing the required current and of withstanding the

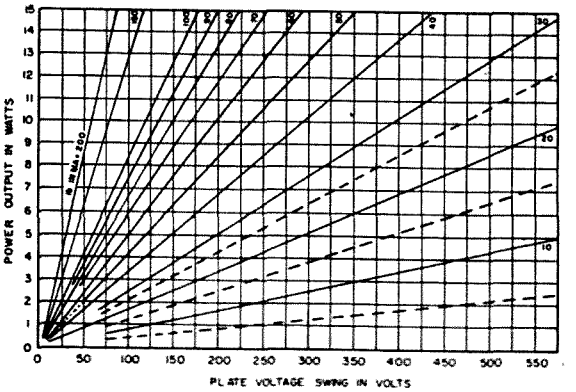


Fig. 3 Output Power Calculation Graph.

required voltage. If several types meet this requirement, choose the one having the smallest value of Eb_{min} at the required current. This will give you the greatest power output. However, if you think you may have trouble getting driving power, then pick the tube type requiring the smallest value of Ec_{max} as listed in Table I.

With a tube chosen, note down its rated plate dissipation, as well as the values of EB_{min}, Ec_{max}, screen voltage, and grid current required to produce the needed value of plate current. Also note down the G1-G2 Amplification Factor. This is listed for newer types; for older types, it is approximately equal to the amplification factor of the tube when triode-connected and this value is usually listed.

Now, subtract the value of EB_{min} from the plate supply voltage to determine the voltage swing. Using Fig. 3, draw a line up from the voltage swing value until it meets the diagonal line for the value of plate current (in ma) you're using. Now draw a horizontal line from this intersection to the scale at the left, and read off the power output in watts.

Next, multiply the plate *supply* voltage and the plate current (this time, in amps) to determine the input power in watts. Subtract the output power found in the previous step from this input power; the remainder is the power dissipated in the tube. If this value is lower than the rated dissipation of the tube, your design is good—go ahead; if it is higher, pick another tube type or a higher plate supply voltage and start over.

The next step is determination of the grid bias required; for this, we use Fig. 4. Draw a line up from the tube's G1-G2 Amplification Factor until it meets the curved line representing the screen voltage you're using; then draw a horizontal line to the left to determine the basic grid bias.

If the grid must be driven positive (that is, if Ec_{max} is positive), an additional bias equal to half of Ec_{max} must be added to the value found from Fig. 4 to get the actual operating bias. If the grid voltage is zero or negative at Ec_{max}, the bias found from Fig. 4 will be the actual operating figure.

Once we know the grid bias required, we can easily determine how much driving voltage is required. Just add together the bias voltage and the value of Ec_{max}. When adding, consider the bias voltage to be positive and take the sign of Ec_{max} as listed, so that if Ec_{max} is positive, the driving voltage will be greater than the bias, and if Ec_{max} is negative, the driving voltage will be smaller than the bias value.

With the driving voltage determined, driving power required can be calculated by multiplying the drive voltage by the grid current (from Table I) and taking 90 percent of the product. Actual drive applied should be at least 5 and preferably 10 times the figure thus

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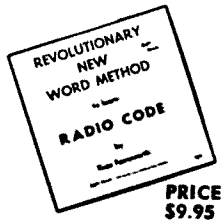
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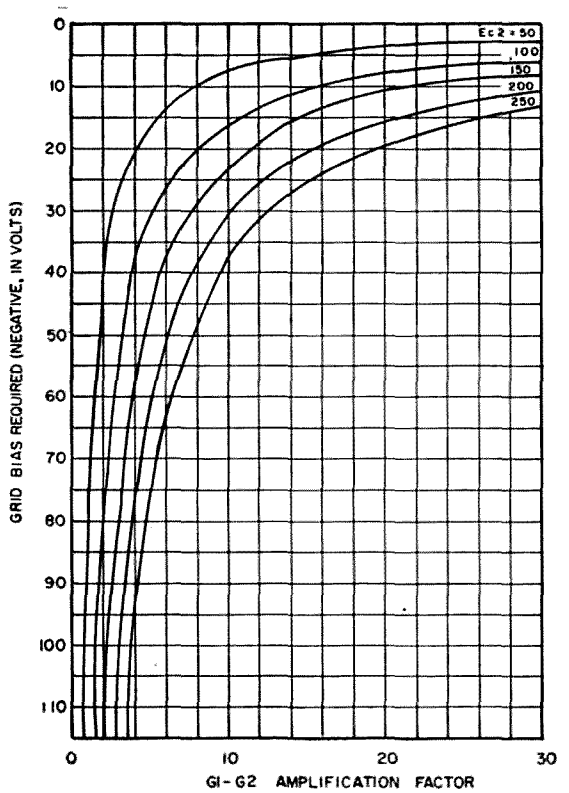


Fig. 4 Grid Bias Determination Graph.

found, since the calculation takes no account of circuit losses which cannot be avoided in practice.

To show you how this procedure works, let's go through an example. Suppose that we want to build a mobile rig in the 10- to 15-watt range. We have available a 300-volt power supply, so our supply voltage is fixed. Space is at a premium in most modern cars, so we want to use only miniature tubes. Before choosing the tube, though, we must find the plate current requirement; we do this by dividing 300 volts by 15 watts, getting an answer of 50 ma.

Scanning Table I shows us several miniature tubes which can handle this assignment: the 6AQ5A passes 50 ma at an Eb_{min} of 60, an Ec_{max} of +13, and 2.4 ma grid current; the 6BQ6 (not a miniature, but a very small octal) passes 40 ma at an Eb_{min} of 50 and Ec_{max} of 0; and the 5763 passes 50 ma at an Eb_{min} of 50, an Ec_{max} of +9, and 2.4 ma grid current.

Were size not an important factor, the 6BQ6 would be the best choice since its Eb_{min} is as low as any of the three, and its driving power requirement is zero. However, considering physical size, the 5763 is our choice. Let's note down all the key factors for this tube, at 50 ma.

TUBE TYPE: 6AQ5A PLATE DISSIPATION: 12 W
G1-G2 Amplification Factor: 9.5 Ec2: 250

Ip	Eb_{min}	Ec_{max}	Ic
10	25	- 7	0
20	35	- 1	0
30	45	+ 4	1
40	50	+ 7	1.6
50	60	+13	2.4

TUBE TYPE: 6BQ6 PLATE DISSIPATION: 11 W
G1-G2 Amplification Factor: 4.3 Ec2: 100

Ip	Eb_{min}	Ec_{max}	Ic
10	25	-10	0
20	30	- 5	0
30	40	- 2	0
40	50	0	0

TUBE TYPE: 829B PLATE DISSIPATION: 30 W
G1-G2 Amplification Factor: 9 Ec2: 200

Ip	Eb_{min}	Ec_{max}	Ic
25	30	- 5	0
50	40	+ 2	2.5
75	50	+ 8	5
100	70	+15	8

TUBE TYPE: 832 PLATE DISSIPATION: 15 W
G1-G2 Amplification Factor: 6.5 Ec2: 250

Ip	Eb_{min}	max	Ic
10	30	-17	0
20	50	- 9	0
30	70	- 3	0
40	90	+ 2	0.2
50	100	+10	0.9

TUBE TYPE: 5763 PLATE DISSIPATION: 12 W
G1-G2 Amplification Factor: 16 Ec2: 250

Ip	Eb_{min}	Ec_{max}	Ic
10	25	- 5	0
20	30	0	0
30	40	+ 3	0.8
40	45	+ 6	1.6
50	50	+ 9	2.4

TUBE TYPE: 2E26 PLATE DISSIPATION: 13 W
G1-G2 Amplification Factor: 6.5 Ec2: 160

Ip	Eb_{min}	Ec_{max}	Ic
25	40	+ 2	0.5
50	50	+11	3
75	75	+22	6**
100	100	+35	10**

** = over ratings

TUBE TYPE: 807 PLATE DISSIPATION: 30 W
G1-G2 Amplification Factor: 8 Ec2: 250

Ip	Eb_{min}	Ec_{max}	Ic
10	30	-19	0
20	30	-10	0
30	40	- 5	0
40	60	- 2	0
50	60	+ 3	0.8
100	110	+20	3.2

TUBE TYPE: 6146 PLATE DISSIPATION: 25 W
G1-G2 Amplification Factor: 4.5 Ec2: 150

Ip	Eb_{min}	Ec_{max}	Ic
25	20	-15	0
50	40	- 3	0
75	50	+ 5	2
100	60	+12	4 (max rating)

Table I Key Characteristics of Popular Tubes.

The characteristics are these: Plate dissipation, 12 watts. G1-G2 Amplification Factor, 16. Screen voltage, 250. Eb_{min}, 50. Ec_{max}, +9. Grid current, 2.4 ma.

With a supply voltage of 300 and Eb_{min} of 50, the swing is 300 — 50 or 250 volts. Turning to fig. 3, we go up from the 250-volt point until we meet the 50-ma diagonal line, then left to the power scale and learn that our output power will be 10.7 watts.

The input power was specified as 15 watts. Subtracting the 10.7-watt output power from the 15-watt input power leaves us with 4.3 watts being dissipated in the tube. Since this is well within the 12-watt dissipation rating, we can proceed.

The next step is determination of grid bias required, from Fig. 4. We draw a line up from 16 (the G1-G2 Amplification Factor) until it meets the 250-volt curve, then move to the left and read the basic bias as 25 volts.

Since our maximum grid voltage is positive, we must add half of Ec_{max} or 4.5 volts to this figure to obtain operating bias as 29.5 volts. A 30-volt figure is easier to handle in calculation, and the half-volt added by rounding off won't affect the accuracy of the design.

With 30 volts of bias on the tube and an Ec_{max} value of +9, the driving voltage required will be 30 + 9 or 39 volts. Drive power will be 90 percent of 39 volts times 0.0024 amps, or approximately 0.084 watts. We multiply this by 5 to allow for circuit losses. Thus, the driving stage should be capable of supplying at least 0.42 watt to the amplifier. This requirement can usually be met by a crystal oscillator.

Even with the design complete so far as tube factors are concerned, though, several factors connected with the circuit itself must be determined. The two most important of these concern grid bias. and the stage load.

You'll recall that we found out, in our example, that we needed a 30-volt bias on the grid of our 5763. We just left it up in the air, at that point, as to how we would obtain this bias.

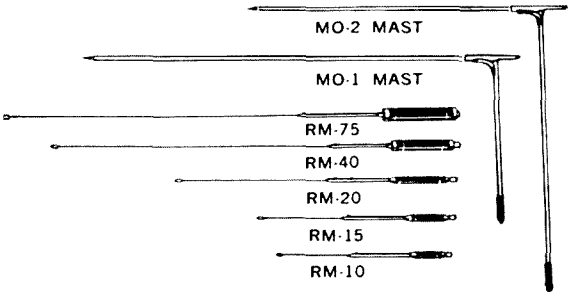
In practice, though, the bias must be provided; it can be obtained from either of two sources in most cases. We can either provide a fixed bias supply (either a battery or a special negative-voltage power supply called a bias pack), or we can let the tube furnish its own bias through rectification of part of the RF input signal, using the grid current flow through the grid return resistor to develop a voltage drop which provides the proper bias value. This second technique is known as grid-leak bias; you can see that it will work only if the tube draws grid current. If the tube operates with zero or negative maximum grid voltage, fixed bias is the only usable method.

However, if your design will allow the use of grid-leak bias, it is to be preferred for sev-

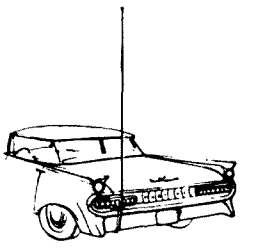
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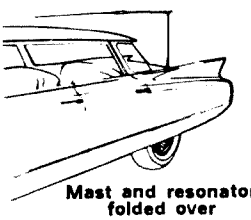
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Mast and resonator in mobiling position



Mast and resonator folded over

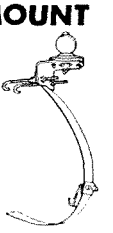
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RM-20	20 meter resonator	83" max. - 78" min.	7.95
RM-40	40 meter resonator	92" max. - 87" min.	9.95
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eral reasons. The most obvious is that eliminates a number of components. It also tends to be self-regulating, especially if the amplifier is to be modulated for phone transmissions. The only major disadvantage is that all bias disappears if anything happens to stop the driving power (such as oscillator tube failure) and consequently the amplifier tube is subject to damage.

To determine the resistance value necessary for grid-leak bias, just divide the grid current (in amps) into the bias voltage required; the result is the resistance, in ohms, of the grid resistor. If this resistance is smaller than about 10,000 ohms, put an rf choke in series with the resistor at the grid end to prevent the resistor from loading down the driving stage; if the resistor is larger than 10,000 ohms, the rf choke is not necessary.

While we're in the grid circuit, we might as well take a look at the matter of providing enough driving voltage. This is not quite the same as getting enough driving power or current; to go back to our earlier example, less than half a watt of power and only 2.4 ma of current are necessary in the grid circuit—but the voltage must be at least 39 volts peak. If the amplifier is fed from a separate oscillator through a coax link, the voltage across the link may be only about 5 volts for half a watt of power. In this case, a tuned grid circuit to act as a voltage step-up transformer is a must; overlooking this point has caused many a beginning transmitter designer to tear his hair.

On the other hand, if the amplifier is fed by another stage on the same chassis, and is coupled to that driving stage by a simple capacitor coupling, the chances are that the swing across the driver-stage output is greater than 39 volts peak; this means the tube will be over-driven, resulting in excessive grid current and too much harmonic output.

In either event, the remedy is the same; adjust the level of the driving voltage until it matches the calculated value. If you're using grid-leak bias and adjust the drive for rated grid current, the voltage is automatically correct.

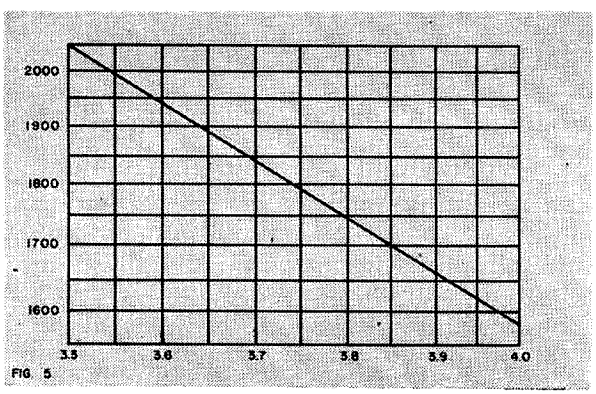


Fig. 5 LC Product Graph 3.5 to 4 mc.

With the grid circuit taken care of, we're ready to look at the stage load. In practice, the utlimate load may be either an antenna, or another amplifier stage—but to the tube, the load is always the same: the impedance of a tuned tank circuit.

You specified the value of this impedance when you picked the values of plate supply voltage and plate current; the load impedance must be equal to the supply voltage divided by *half* the plate current (in amps). However, a wide range of actual tank circuits can be made to have the same impedance, by the technique known as "loading."

Since a tank circuit, when acting as a coupling between an amplifier and another load, performs the function of a transformer, the impedance of the tank circuit will depend largely on the impedance of the ultimate load. However, the design of the tank circuit itself will also influence the operating impedance, irrespective of the load. This is so because of the transformer effect: a 2-to-1 transformer will show higher primary impedance than would a 1-to-1 transformer, if the same load were connected to the secondary of each. Roughly, the amount of transformation provided by the circuit is proportional to the number of turns in the coil.

Thus, a tank circuit with large inductance (many turns) and low capacitance will transform relatively low antenna impedance up to fairly high values of primary impedance. Only a small coupling loop for the antenna is necessary, and the circuit is said to load easily.

However, coupling is only half the job of the tank circuit; the other duty of the circuit is to iron out distortion and remove unwanted harmonic frequencies from the output.

To do this part of the tank task properly, large values of capacitance are needed. The greater the capacitance, the more energy the circuit can store during each driving pulse and the greater will be the "kick" to the "flywheel" between pulses.

Thus, a high-C circuit is needed for good harmonic reduction, while a low-C circuit provides ease of loading. Most designs represent a compromise between these needs.

A popular way of specifying this same characteristic of the output circuit is to specify its Q. This is the same thing we've been discussing, because the Q of the circuit is proportional to the product of the circuit's capacitance and the required circuit impedance. The greater the capacitance, the higher the Q. Q values normally range between 10 and 30, with higher values needed for phone than for CW operation.

Note that, so far, we haven't mentioned much about specific values in the tank circuit except those for the capacitance. The reason for this is that you can choose from a number

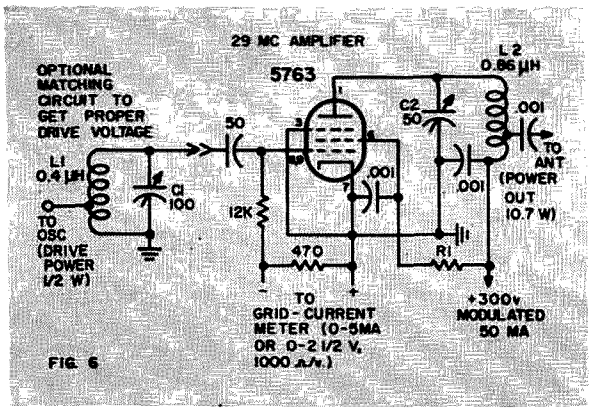


Fig. 6 Example of Class C Amplifier Design.

L1—Slug-tuned coil (Miller 20A477RB1 or equiv.); tap as necessary to obtain proper drive voltage. Try tap ¼ way up to start. Couple to osc. coil with link.

L2—Air-wound coil, 9 turns, 1¼" long, ¾" dia. (Air-Dux 608 or equiv.); tap as necessary for proper loading. Start with tap 1 turn up from cold end, move higher by ½-turn steps.

R1—Screen resistor, 2w. Pick for 250-volt reading on screen with normal drive and loading. Start with 50k ohms and work down.

C1—Ceramic or mica trimmer, 10-100 mmf.

C2—Air-spaced trimmer, set to approx. 30 mmf. when in tune.

of types of tank circuit: the conventional single-ended tank, the balanced tank, and the pi-network are the most popular. Details of these circuits differ; however, the effective capacitance across the circuit must be the same for all three, at the same values of loading. Thus, calculation of the capacitance value follows the same procedure no matter which tank circuit you're using.

However, beyond this point the design details differ depending on the tank circuit you choose. The details of output-circuit design are adequately covered in both the ARRL Handbook and the Editors & Engineers Radio Handbook (see bibliography) so we won't repeat them here.

If you do choose the conventional single-ended tank circuit, though, you can complete the design rapidly simply by choosing a value of inductance which will resonate at your desired operating frequency with the capacitance value you just calculated. The simple way of determining the value of inductance necessary is by use of a chart of LC products.

These charts make use of the fact that the product of inductance times capacitance is constant for any specific frequency. Thus, by looking up the LC product for your operating frequency and dividing it by the capacitance value you're going to use, you can determine the necessary inductance.

Such a chart, in graphical form, for the frequencies from 3.5 to 4 mc is shown in Fig. 5. In this chart, capacitance values are in mmf and inductance is in microhenries. To use the chart, simply read up from the operating frequency to the diagonal line, then move to the left to find the LC product.

This chart also applies to frequencies in the bands 7 to 8 mc, 14 to 16 mc, 21 to 24 mc, and 28 to 32 mc by using correction factors. Correct the frequency by dividing the frequency you're using by 2, 4, 6, or 8 to get a figure between 3.5 and 4. Correct the LC product by dividing by 4, 16, 36, or 64, respectively.

For instance, if we're going to operate at 29 mc, we divide 29 by 8 and get 3.625. This is the "frequency" at which we enter the chart; the LC product corresponding to this frequency is 1915. Now, we divide 1915 by 64 to get our true LC product, which is 29.9.

To carry the example on through, let's calculate the tank-circuit values for the transmitter used as an example earlier. Our 5763 was operating at 300 volts and 50 ma and thus required a load impedance of 3000 ohms. Making reference to the charts of capacitance versus impedance to be found in the ARRL handbook, we find that a capacitance of 35 mmfd produces a Q of 20, adequate for our uses.

Now, we divide 35 into 29.9, and learn that our tank coil's inductance should be 0.86 microhenries. A check of available air-wound inductors shows that 9 turns of 8-turn-per-inch, ¾-inch diameter stock (Air-Dux 608 or B&W 3010) will provide this inductance; a 3-to-30 mmf air-spaced trimmer padded with, say, 20 mmfd of fixed capacitance will do for the capacitor.

The complete schematic diagram for this amplifier is shown in Fig. 6, with all pertinent operating voltages and other design factors pointed out.

With this, we wind up our discussion of basic circuit design with electron tubes. If you're satisfied, by now, that circuit design is *not* too complicated and involved for your tastes, you may be interested in some of the books listed in the bibliography below. In reading them, you may find yourself getting in a bit deep in mathematics, or entangled in a tenuous thread of involved reasoning—but don't let them scare you away from designing, the most fascinating part of ham radio construction.

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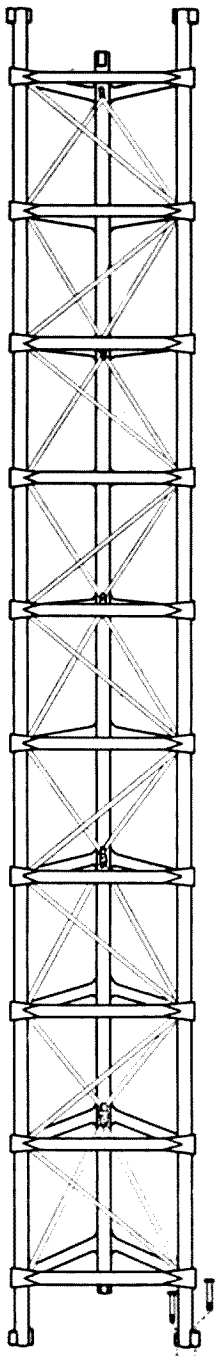
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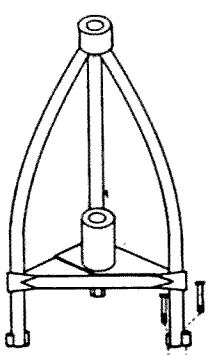
KTV

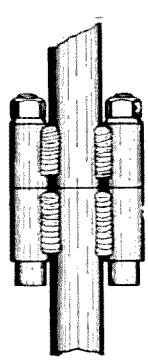
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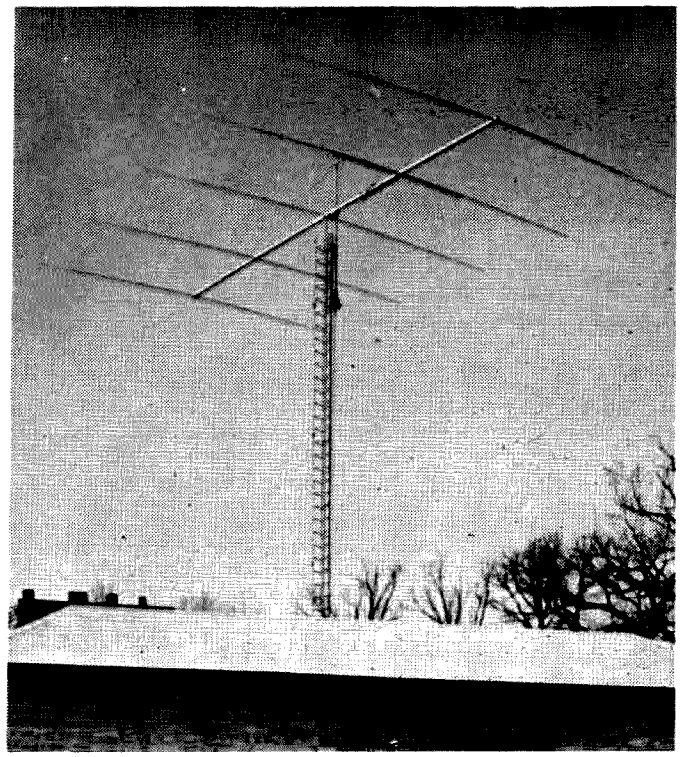


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Non-technical article on the veracity or lack-of-it of a useful instrument.

Are You Being Lied to, OM?

S. P. Wilds KZ5SW/W4GVD
Box 2519, Balboa, Canal Zone

Since the advent of the low-priced commercial SWR Bridge, the Standing Wave Ratio of "antennas" has become a major source of conversation, and CONCERN, of a larger percentage of hamdom. The purpose of this article is to dispel some of the mis-information currently going the rounds as "gospel" regarding the understanding of what these gadgets tell us. I think that most people "know" why a low SWR is desirable, but let's list them, as we have heard "on the air." A low standing wave ratio will provide:

1. Maximum transfer of rf from the shack to the antenna.
2. It indicates that the antenna is resonant on the operating frequency. (?)
3. It makes the transmitter load easily.
4. It minimizes TVI from transmission line radiation.
5. Many rigs with limited-range pi-nets or fixed-output-impedance require a close-to-50 Ohm "load."

As a result of this school of thought, a great deal of effort has been put forth by many hams to be sure that the "reflected power" on the bridge reads as close to "O" as possible. However, while this will almost always result in achieving result listed as number 5 in our objectives above, it doesn't necessarily mean that the other four are also being arrived at.

The ability to load easily is of primary importance to just about all of us, as is the "necessity" to be able to state "SWR here is less than 1.01 to one" for prestige purposes if nothing else. This piece is directed to those who are genuinely concerned about getting maximum performance for their dollar investment. First, here is a simple check to find out whether all is what it seems to be at your QTH.

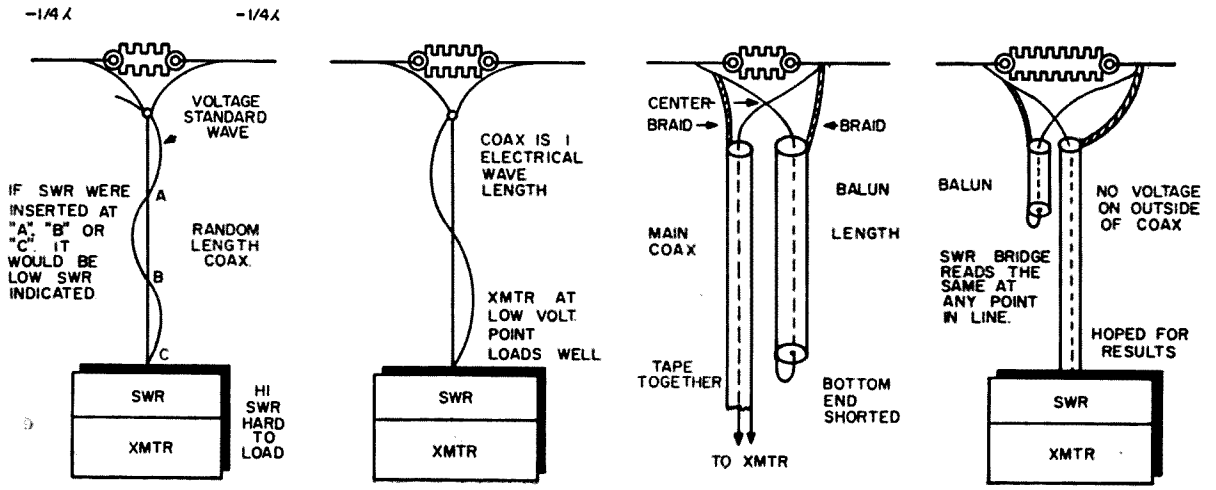
1. Tune up the rig as close to perfectly as possible on your favorite frequency.
2. Make careful notes of the plate current, plate tuning and load control settings.
3. Read and note down the exact reflected power indication.
4. Insert a length of coax about 15 feet long between the SWR Bridge and the end of the transmission line to the antenna.
5. Repeat steps 1, 2, and 3. Compare the two sets of readings.

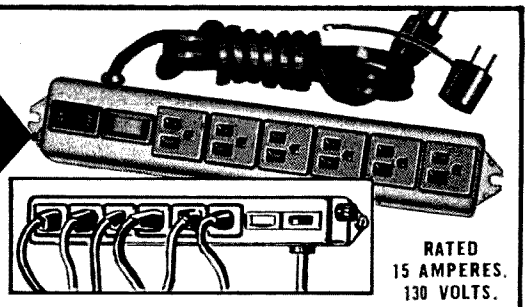
If there is a considerable difference in any or all of the readings or settings, do one of two things. The easiest is to tear up your notes and forget the whole thing. The second requires some antenna work and an understanding of why fate has done you so wrong. (Incidentially if all the readings above stayed close to the same, you are indeed either darn lucky and have the world at your finger-tips or you don't need this article and have skipped it by now.) If you decide that something has to be done bear with us.

Let's first find out why this miserable condition exists.

The SWR bridge that most of us play around with is a voltage indicating device and as such indicates voltages existing on the line at the POINT OF INSERTION ONLY.

If the actual standing wave ratio is not too high, say less than four to one, there is a point every half-wave length along the line where the rf voltage is low and the current is high. If the bridge is inserted here, the SWR reading may look *good*. If this is the point where the transmitter feeds it, the rig will load well



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(except you may have trouble UN-LOADING to keep the plate current from being to HIGH at minimum loading and at plate current dip!). At this point the bridge may read a low SWR, but the *actual* SWR is high on the transmission line. The purpose of the extra co-ax is to shift the transmitter and the bridge to a different point. Remember that a truly flat line has NO variation to speak of either in current or voltage throughout its length. Hence the bridge could be inserted at *any* point in the line and would read the same as at any other point. Before going further, it would be well to point out that the low *indicated* SWR phenomenon on the line with the medium high *actual* SWR has its distinct uses. It enables many of the "tri-band" type antennas to be loaded with ease. If your tri-bander has neither a Gamma or Omega Match or some type of Balun system, it is undoubtedly being loaded by the system of putting a voltage null at the end of the coaxial line. Hence the instructions to use a multiple of a *specific length* of coax. Have you found on your home-brew antenna that you could "lower the SWR" by trimming the length of the transmission line? Same deal. You get a low indicated SWR, the actual SWR can still be very high. This results in increased losses, possibly high TVI radiation from the line and it does *not* mean that the antenna itself is "on frequency."

What to do about it, will be taken up next. Regarding the commercial tri-band beams, there is very little that can be done by the average ham. The element lengths and trap coils are hard to adjust because they all interact, especially on the low frequency end. There is one change that I found useful on a trap tri-bander that was fed with coax, one side of the driven element being grounded, and no gamma system supplied. I ungrounded the grounded side of the driven element, made a balun of 12 turns of the transmission line into a coil six inches in diameter at the antenna itself. I connected the center of the coax to one side of the split driven element, the braid to the other side, being careful *not* to ground the braid to the boom. This materially helped the indicated and the actual SWR of the system. This is about as far as you can conveniently go with modifications to the manufactured multiband antenna. The single band systems are a different kettle of fish. Remember that a split half-wave element is basically a balanced load. The transmission line is unbalanced. Therefore we must employ a device to match the two or we will have standing waves on the line. This matching may be done with a simple coil balun as just described on the high frequencies or by means of a linear balun on the low bands. See the various antenna manuals for the complete information.

Another means of accomplishing the desired result is to use a Gamma or Omega matching system. This is an excellent means of getting the most from your station. It is very popular with the home-brewer of beams, quads, etc., because it is efficient. Commercially, they have been left behind in order to reduce costs, to make simpler antennas to meet competition, and for ease of installation, (at some loss of efficiency). The perfectionists will dig the rest of the information on how really to get the very most from his antenna from the usual sources. Is it worthwhile? I suggest you listen to the ZL's and VK's on the air. Virtually the only ones that you *hear consistently loud and clear* are the antenna nuts. Be it a beam, quad, Vee, or ZL special, it is tuned to a gnat's eyelash. Conspicuous by their absence are the dipoles, "long wires" and the rest of the make-do, cut-to-formula and sling up affairs. The *properly used* and understood SWR bridge is a very useful device to help you attain best performance. Remember though, if left in one place while making adjustments, it can lie in its teeth.

. . . KZ5SW

How to Scrounge a Deluxe Junkbox

Mikarad Capacitorri Ex-K9AAI

AMATEUR radio operators delight in showing off their junk boxes. Practically every author mentions that his home brew gizmo can be built with junk box parts for little or no cash outlay. But, how are these parts accumulated?

This then, shall be my first (and probably last) contribution to amateur radio in more than fifteen years of being on the air. Study my contribution carefully. It reveals the secrets of a dedicated, A-1 scrounger.

First off, let's define scrounger. To scrounge is to steal slyly, pilfer, cadge or sponge. Since all amateur radio operators are honest, trustworthy, loyal, etc., we have narrowed down scrounging to the fine and respected art of sponging. An amateur radio operator intent on obtaining parts for the junk box for little or no cost, therefore, must become an accomplished sponger.

In all sincerity and with greatest respect, I must reveal that as scroungers, the Green Mountain Boys represent the acme of perfection. It has been my good fortune to become associated with these distinguished practitioners from W1 Land. The United States Government has not yet recovered from the shellacking it took out East in surplus deals after World War II.

The W1's, however, have one serious shortcoming as scroungers. Their Yankee heritage demands they live on interest and forestall using the principal at any cost. The serious scrounger must learn that there is no honor among thieves, that is spongers. He must be quick to recognize when a W1's accumulated interest has depleted to a dangerous level. A W1 would rather lose his right arm than let his townsmen know he is drawing against his principal.

I know of a K8 that recognized this shortcoming in a W1 and scrounged a complete RAS-5 (U. S. Navy version of the HRO) for $15. A surplus dealer already has offered him $35 for the coils alone. Anyone care to make me a better offer? Do not belittle the W1, however. He sold me a gallon of watered, low-grade, genuine Vermont maple syrup for $7.50.

The finest training for scrounging comes from being a Novice. Without discounting the inherent and sterling qualities of the Old Timer, no better apprenticeship is known. Imagine the youngster who can, with a sob and glistening tear, sever the heart strings of the most callous Marine drill instructor. Imagine this very same youngster pleading with his parents (and grandparents and aunts and uncles) for, "Just one little old 75A4, a 3-element beam for 40 meters and an 80 foot, self-supporting tower."

I've seen Novice stations that put the National Bureau of Standards to shame—VFO and all. Here then is the material to replenish the ranks of our most glorious hobby. Heed this prediction well, "Today's Novice will be tomorrow's scrounger."

Our present day world is dominated by the cold war, missiles, nuclear warheads and most important, electronics. What finer place for a scrounger than in an electronics company? There are only two worthwhile positions in electronics; that of general manager and janitor. When making your choice, forget about the lack of formal education, integrity and pride. None of these traits are required for either position, and in truth, can be most harmful to the journeyman scrounger.

Another consideration that must be taken into account is your choice of circuits. Get a



"... They hide parts under garbage"

job with a communications or industrial controls outfit if you prefer working with vacuum tubes. Remember the article in a prominent amateur radio magazine[1] that stated that it doesn't appear that there will be much use made of transistors in amateur work? They may still be right.

The transistor man should get into a digital computer company. Man, do you have a choice of quality diodes, miniature potentiometers, tantalum capacitors and blank etched circuit cards! Components for transistorized power supplies are also available.

There is a decided disadvantage with computers, however. They use transistors for high-speed switching and in amplifiers that operate only up to one megacycle. You may have to buy high frequency transistors.

The mark of an accomplished scrounger is to take advantage of all situations. High cost of living has forced many men to moonlight. That is, to get a second job. Become general manager of a computer company and janitor with a communications outfit.

As general manager you've got it made. Initiate an austerity program as soon as possible. Take a hint from the military. Demand that defective printed circuit cards and modules be discarded instead of repaired. If the chief engineer rebels, back him into a lab and question his intelligence, and better yet, his pedigreee. You'll become hero of the lab and the union will think of you as enlightened management. You will be able to scrounge enough parts to start an electronics distributorship.

Of course the company will start losing money and the stockholders will scream for your scalp. At this point you will probably start acting like a storybook executive and try to save the company. Resist the temptation.

[1] QST Oct. 1948, the "Transistor" — an Amplifying Crystal.

You only took the job to scrounge parts. If you want to buy parts for the junk box, forget about amateur radio and get a Citizen's band rig.

Being janitor is another story. At this job you work best at night. However, make sure to get to work at least one hour before the day shift knocks off. This gives you an opportunity to become acquainted with the lab technicians.

Lab technicians are dominated with the constant fear of having to breadboard circuits with parts that have been used before or that have lead circuits shorter than one inch. They live in mortal fear of putting together circuits with some semblance of tidiness and order. To produce a neat circuit is to admit their job is not difficult. In addition, a mechanically and electrically sound circuit usually works within design specifications the first time tried. Any technician making such a circuit will be hauled into kangaroo court and tried for treason. It is these very circuits that louse up overtime by eliminating the need for debugging. Let's face it, most circuits are copies of those found in the Preferred Circuit manuals put out by the military. So why kill the job?

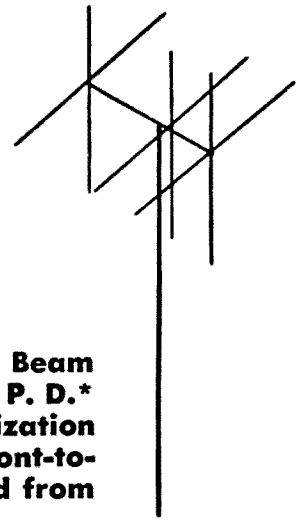
A janitor's job can be dangerous. Most of your scrounging will be done after the lights have been turned off. There are many danger areas in an electronics plant. Relax for a moment and you are liable to find yourself at the bottom of an elevator shaft. With any luck your injury might be minor, like a broken spine or compound fractures of both arms and legs. A head injury, however, may leave you with scrambled brains. Should this happen, beware. The head of personnel will hear about it and before you can decline, you'll be Marketing Manager. But, then, those are the breaks.

So far I've only told you about getting started as a scrounger. Let's get down to the finer points. Teflon insulated wire and coax are easy to come by. Keep your eyes open when cables are being fabricated. Cable lengths are always odd multiples of the amount of wire and coax stored on spools by the manufacturer. There is always a piece left on the end of the spool that is a few inches too short. Glom on to it.

Resistors, transistors, diodes, capacitors, coax connectors, terminal boards and a multitude of other good parts can always be found in waste paper baskets. As mentioned before, technicians discard parts that have been used before and those that have short leads. Because they have a guilt complex, they hide parts

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under garbage. Be on the lookout for sloppy waste paper baskets. The ones with half empty coffee cups and partially eaten sandwiches covered with cigarette butts will yield a fortune in parts.

No lab is complete without a Polaroid camera for taking pictures of scope patterns. The empty film spools make excellent spreaders for feedlines. Since lab technicians are the world's worst photographers, your supply of spools is unlimited.

As you can see, opportunities for scrounging radio parts are unlimited. However, I have purposely given you only the bare essentials as a beginning course. For the small sum of $5.99 you can receive a complete home study course. Send your certified check or U. S. Postal Money Order to:

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Soldering Iron Tip

Tip

You'll get a lot more mileage from soldering iron tips if you rig a way to keep them cool (but not cold) except when you're actually heating work. The idea is to switch a resistance into the line to drop the voltage about 50%, keeping the iron warm but preventing the tip from overheating. When you are ready to solder, short out the resistance and full voltage is applied.

You can use a standard SPST toggle to do the switching. I've put together a soldering iron rest in which the weight of the iron opens a normally-closed microswitch to put the resistance in series with the iron; lifting the iron closes the switch and permits the full 110 volts to go to the iron. For a resistance, I use a 7½-watt, 110-volt bulb, but other irons may require different size bulbs. . . . W2QPQ

The Local Net

How to double the fun of Ham Radio

George Thurston W4MLE
3407 Prock Drive
Tallahassee, Florida

ANY town with two or more amateurs which doesn't have a local net is missing some of the best fun in ham radio. The uses are limitless, the fun is endless and the value is considerable. The cost is small, the junk box comes into its own and the frequency doesn't especially matter, so long as everybody is on the same frequency, and provided it is above 28 mc, where skip, fading and QRM are not major problems.

Tallahassee got into the local net business to provide emergency communication between 80, 75 and 40 meter Key Stations if phone service should go out. But it quickly turned out to be so much fun that practically every active amateur in town now checks into 29,560 kc several times a week.

The Tallahassee Key City Net is probably typical—or certainly could be. In between emergencies, which so far have been few and far between, there's a continual round of activity which includes checker games, rag chewing, DX chasing on ten, DX chasing on other bands (details in a moment), experiments with extended groundwave communication with other towns, traffic handling, contests, small practical jokes and helping passing mobiles.

We have no scheduled meetings, no roll calls, no membership lists. The trick is to have completely separate stations for the local net, so that you're always on the net, no matter what other band you may also be working.

In addition, each station should use a squelched receiver on the net frequency, and leave it running all the time—24 hours a day, seven days a week.

That's the sine qua non of a good local net —separate stations for the net, using squelched receivers which constantly monitor the frequency.

A separate station is a must. You don't want to limit your operating to the local net only. You normally use the big rig for your favorite HF bands for DXing, rag chewing, traffic or other things. You can't conveniently halt everything and go have a look on the local frequency at scheduled times. Besides, some of the best fun and greatest use of the local frequency comes from using it ***in conjunction*** with operation on the big rig.

The net station can be quite simple. At W4MLE it came entirely from the junk box, without a cent of original expenditure for it. A crystal oscillator doubles, a driver doubles again to drive an old 815 I happened to have. It runs about 45 watts, screen modulated. The antenna is a fish-pole groundplane (8 feet of wire taped to a bamboo fishpole mounted atop the TV antenna mast). The receiver is a crystal converter working into a command set. Since the receiver is never tuned, calibration is immaterial and the xtal converter oscillator uses a discarded 27 mc citizen's band xtal. Almost any frequency converter xtal will work, if you can find a command set (or other inexpensive receiver) to tune the difference frequency. The *if* should be pretty broad. QRM is not a problem, and transmitting crystals seldom hit the same exact frequency on their fourth harmonics, even when their fundamental frequency is theoretically the same. You don't want to have to retune for each net member station.

The receiver's detector bias (not used for AVC in the command set) is used to operate a squelch control tube. There are dozens of squelch circuits—most of them quite simple. (73, Dec. 1960).

Many commercial transceivers have squelch built into them. The Heath Tenners, Twoers

and Sixers make exceedingly fine local net rigs and although they have no built-in squelch, it is simple to provide one.

The squelched receiver bit, though more subtle, is just as essential to a good local net as a separate transmitter. No one likes to listen to receiver hiss, ignition noise and power line interference all the time. The squelch eliminates all this, so long as the channel is vacant. But the receiver is always there, listening for signals without disturbing you until it hears something.

Without squelch, the tendency is to turn the receiver way down, or turn it off entirely when not expecting a call. This tendency is disaster to successful operation of the net for the same reason it would be disaster if the local police turned their radios off after each QSO and maybe listened in only at scheduled times or when called on the phone and told to listen. Squelch is the answer to the old complaint "We had a local net once, but you could never get anybody on it, except for scheduled net drills, and it just sort of folded up."

We undertook the Key City Net as a Tallahassee Amateur Radio Club project with the minimum objective of getting at least the AREC Key Stations equipped with separate 10-meter gear. These stations are capable of auxiliary power operation in emergencies and we wanted to be sure they could keep in touch with each other by local radio in case land lines go out or get overloaded. Each Key Station guards a separate HF emergency net and the Key City Net is used to transfer traffic from one HF net to another when needed, as well as to coordinate the overall operation.

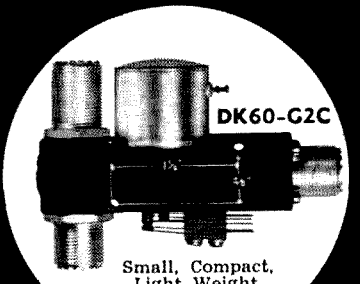
Ten meters was chosen for several reasons. (1) 29,560 had already been established as a Western Florida frequency and was in use in most other cities in the panhandle, where 10-meter nets existed. This opened the possibility of extended groundwave work and long haul relays in case of long-skip or blackout problems on the HF bands. (2) Most mobiles can operate 10 with existing all-band commercial gear. (3) Ten meter equipment is relatively uncritical to build and equipment is simpler than VHF. (4) Many non-Key stations would be able to use the frequency with their big rigs, even before or without getting separate station capabilities on the net.

These were our main reasons for picking 29,560 kc. Other cities may have equally good reasons for choosing frequencies in the 50, 144 or 240 mc bands.

Vertical omni-directional antennas turned out to be a "must." For some reason, horizontal

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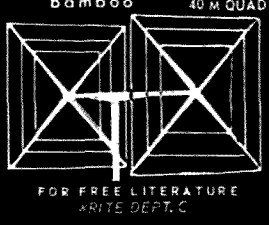
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antennas just didn't work well for local contacts, even when worked against horizontal receiving antennas. There is no such thing as getting an antenna too high. And a very low VSWR is essential to good antenna efficiency. These general rules probably will hold true regardless of what band or frequency is chosen.

Unexpected bonuses began to show up almost as soon as a few of us got separate equipment going on ten.

K4YPI, W4CMG and I like to chase DX at the low end of 80 cw, coordinating our digging by using ten meter phone. That's triple-diversity reception using the other guy's antennas and receivers to hunt DX for you. Early one morning my squelch broke and K4YPI told me of a JA coming through on 3509 kc. The fact that I didn't work him for my 3.5 mc WAC was no fault of Norm or the operation of the net.

Our local net rigs have worked short skip stations on Sporadic E from Maine to California; from KP4 to KZ5. Even the boys with the Tenners get out.

Checkers? W4CMG and WA4AMH have great sport.

Mobiles? The tenners work fine from a 50-watt electric shaver inverter plugged into a car's cigarette lighter socket.

Whenever a Florida mobile comes through the area, he knows he has a chance of finding someone on 29,560. The frequency has recently been adopted statewide for local and mobile AREC work. The State Road Department has printed the Official Florida Road Map with a small "box" on the face of the map which says "Statewide Amateur Radio Mobile Calling and Emergency Frequency 29,560 kc." The map is handed out free to most tourists entering the state at an Official Welcome Station. Eventually, mobiles may be able to drive the thousand miles from Pensacola to Key West without retuning the receiver and without losing contact with fixed stations along the route—provided enough stations keep squelched receivers and separate transmitters standing by on the frequency.

Extended groundwave? Tallahassee is surrounded by towns with only one or two active hams who might be unable to run their own local net—but who can work into the Tallahassee net at will, at distances ranging from 16 or 18 miles to 60 or 70. Some of these stations are so located that they can also work into other local nets on 29,560 in Panama City, Ft. Walton Beach and other towns strung eastward from Pensacola. They can (and often do) serve as relays.

A test message originated in Pensacola travelled the 200 miles to Tallahassee with one relay, was delivered via squelched receiver without the use of a landline and a reply sent over the same route in an elapsed time of not more than 15 minutes—and with no haste or special effort at speed at any point in the chain.

This is old stuff to the two-letter-call 200-meter gang but it is rapidly becoming important again as long skip begins chopping up our 75 and 80 meter nets.

Give it a whirl in your area, or fire up on an existing local net frequency with separate station equipment, including a squelched receiver. If you set up a new net, try to pick a frequency which will let you work in with near-by towns without re-tuning. Especially on 144 mc and higher, the more squelched receivers monitor channels which are in regular use in distant places, the more often you'll discover "DX" openings you might not otherwise have suspected. . . . W4MLE

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No need to rack your brains or trace circuits, or wonder what that smudge means that now just reads "6 . . ." Use these labels to mark sockets, trimmers and terminals, or date tubes, etc. (For light-colored surfaces only.)

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2. Type the label desired on the tape.
3. Apply a second strip on top of the first and press on firmly, allowing no bubbles.
4. Remove the second strip from the first. The typed message will now be on the adhesive side of the second piece of tape.
5. Trim the second piece of tape to appropriate size and stick the label in place.
6. The first piece on the typewriter roller may be now wiped with a cloth and used over as many times as desired.

The tape is nearly invisible and will not yellow with age. The letters show clearly, especially if heavy pressure was used in typing to put plenty of ink on the tape. The labels won't smudge or rub off because the ink is under the tape.

This system also makes neat captions on photographs, notations on diagrams in books and manuals, any place where a neat, short message is needed on a smooth, light-colored surface. . . . WϕOPA



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Modernizing the VF-1

Howard Lawrence W2RHD
Munn Lane
Cherry Hill, New Jersey

JUDGING from recent radio contacts, there are still many Heath model VF-1 variable frequency oscillators in use, despite its having been superseded by a later model. The VF-1 used for several years at W2RHD has been modified recently with a resultant improvement in performance that may be of interest to other amateurs. The primary object of the modification was an improvement in frequency stability, particularly on the higher frequency bands. This was accomplished by substituting air trimmers for the ceramic trimmers originally used, providing a more rigid mounting for the two ceramic oscillator coil forms, improving the ventilation of the case, removing some heat generating components from the main case, and adding a double triode oscillator and cathode follower to the circuit.

Very few new components were used. The new schematic is shown in Fig. 1. New components are shown in heavy lines. (Several of the original components are also used in new locations.) The 6AU6 originally used as both an oscillator and amplifier has been rewired to function only as an amplifier as shown in Photo 1. This required a new 33,000 ohm series screen resistor and modification of the grid and cathode circuit. Otherwise the 6AU6 is undisturbed. The OA2 voltage regulator tube and its socket are removed and a 12AU7A 9 pin miniature tube and socket are substituted. The original oscillator circuits are rewired to the oscillator half of the 12AU7A. The grid resistor (2.2K) formerly used with

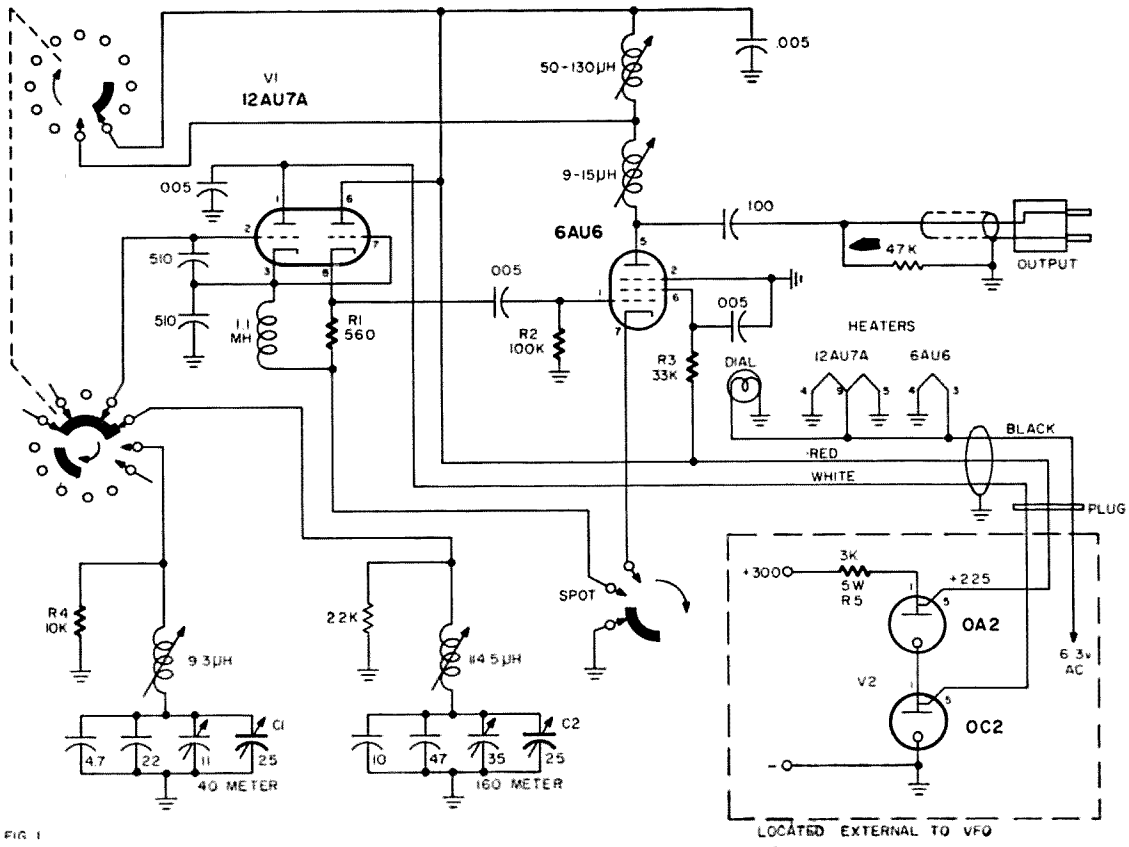


FIG. 1

Schematic of modified VFO. New components are shown in bold.

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500ma 600piv epoxy, sim. 1N2071	.70
750ma 50piv replaces 1N599	.11
750ma 100piv replaces 1N600	.20
750ma 200piv replaces 1N602	.33
750ma 300piv replaces 1N603	.39
750ma 400piv replaces 1N604	.48
750ma 500piv replaces 1N605	.60
750ma 600piv replaces 1N606	.75
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750ma 800piv —	1.25
750ma 900piv —	1.50
750ma 1000piv —	1.95
750ma 1500piv —	3.25
750ma 2000piv —	4.15
2amp 50piv replaces 1N2026	.17
2amp 100piv replaces 1N347	.30
2amp 200piv replaces 1N2027	.45
2amp 400piv replaces 1N2029	.90
2amp 600piv replaces 1N2031	1.35
2amp 800piv replaces 1N1236	1.75
2amp 1000piv replaces 1N3366	2.90
2amp 1500piv replaces 1N3371	4.70
2amp 2000piv —	6.50
2amp Cont. Rect. similar 2N1600	3.50

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2amp 1500piv axial lead	4.30
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12amp 50piv replaces 1N1199	.75
12amp 100piv replaces 1N1200	1.20
12amp 200piv replaces 1N1202	1.75
12amp 400piv replaces 1N1204	2.60
12amp 600piv replaces 1N1206	3.75
12amp 800piv —	6.90
12amp 1000piv —	9.50
20amp to 400 piv. Cont. Rect.	14.00
25amp 50piv replaces 1N248A	1.50
25amp 100piv replaces 1N249A	2.50
25amp 200piv replaces 1N250A	3.70
25amp 400piv replaces 1N2136A	4.75
25amp 600piv replaces 1N2138A	7.75
25amp 800piv —	10.00
50amp 25piv —	2.70
50amp 50piv similar 1N411B	3.98
50amp 100piv similar 1N412B	5.98
50amp 200piv similar 1N413B	6.50
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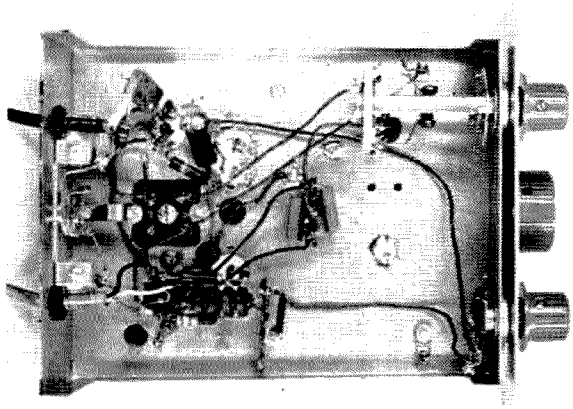
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the 40 meter oscillator coil is increased to 10,000 ohms to reduce the power input to the 12AU7A and thus obtain somewhat better stability. The original 2.2K resistor was apparently used to increase output at the higher frequencies, but since a cathode follower type of amplifier has been added, the extra oscillator output is not needed.

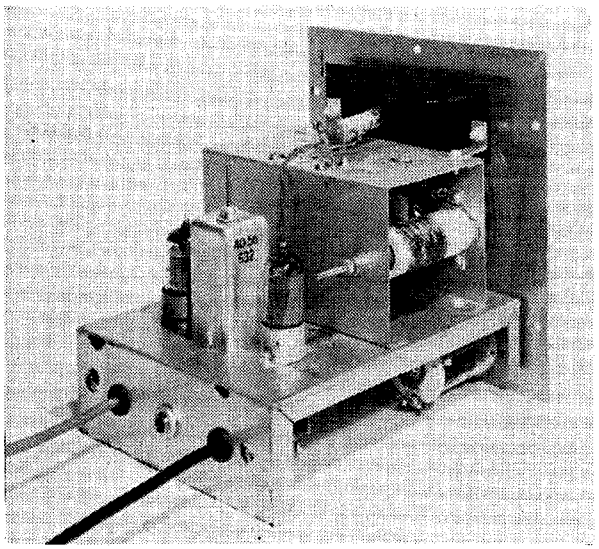
Mechanical rigidity of the two ceramic coil forms upon which the oscillator tank coils are wound has been increased. The mounting screws for the coil forms were loosened and ⅜" by 1" strips of aluminum of a thickness slightly greater than the original spacing between the coil form and the chassis were slipped between the coil form and chassis. The screws were then retightened and the coil forms are now more rigidly supported on their mounting base.

The two 25 mmfd ceramic trimmers used to adjust the oscillator frequency were removed and two Hammarlund APC-25 trimmers were substituted. It was necessary to mount these trimmers slightly towards the rear and towards the centerline of the platform upon which they were originally mounted in order to obtain clearance from the oscillator coils. In the equipment modified, the trimmers adjust near minimum capacity so somewhat lower value trimmers could have been used, making it possible to mount them in their original locations. (See Photo 2.)

The original power switch has been rewired so that the "off" position is now the standby position and the "standby" position has become the spotting position. It was felt



Underside of modified equipment. The 12AU7A is located in the original OA2 voltage regulator position. The voltage regulator and its associated series resistor are externally located to reduce the heat generated within the enclosure.



Top view of modified VFO showing new location of oscillator trimmers.

unnecessary to use the "off" position since power for the VFO comes from an external power unit and this external power unit normally has its own power switch.

It was found that there is a slight difference in frequency between the spotting position and the operating position unless adjustment of the 6AU6 plate coils is properly made. This difference in frequency amounts to two or three hundred cycles, but it is annoying when operating CW. The technique used in adjusting the plate coils for minimum frequency shift is to first adjust the output coils for maximum output and then make a minor adjustment while switching back and forth between spot and operate switch positions until minimum frequency difference is noted.

The oscillator voltage has been reduced to 75 volts, again to minimize heating and its resultant drift. The cathode follower and amplifier are operated at a plate voltage of 225 volts. These voltages are obtained from an external power supply and voltage regulator tubes. The regulator tubes and the related series dropping resistor are located externally to minimize the heat generated within the oscillator cabinet, thus reducing frequency drift and frequency stabilization time. The red lead in the power cable originally used for B+ is used for the 225 volt lead and the white lead in the cable originally used for externally keying the oscillator is used to supply the +75 volts. If the external power source cannot supply a full 300 volts to the regulators, an OB2 can be substituted for the OA2 shown in the diagram.

Additional ventilation was provided by cutting out a 3 x 4 inch opening in the rear of the cabinet above the chassis and then covering this opening with window screen wire. The screen wire is held in place by ¼" wide strips of aluminum. The inside of the cabinet was painted a dull black so that it would absorb any radiated heat and reradiate it to the outside, rather than reflect it back onto the components.

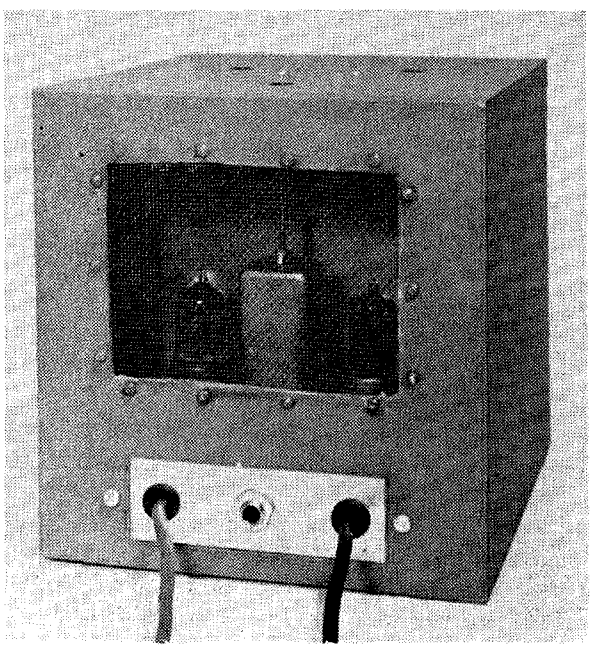
Results

The stability of the VFO is now greatly improved. Since there is very little heat generated, the heat being primarily that of the heaters of the two tubes, the oscillator reaches a stable condition in a matter of a few minutes. Shielding is sufficiently good that on the spotting position most signals can be zeroed in without blanking out the received signal. This is particularly so on the higher frequency bands. The only possible remaining deficiency is the operation of the standby-spot-operate switch. Occasionally when going from operate to standby and back, there will be 100 cycles or so difference in tone. This is completely eliminated, however, if the B+ is shut off at the power supply between contacts instead of opening the VFO cathode circuits.

. . . W2RHD

Parts List (New Parts Only)

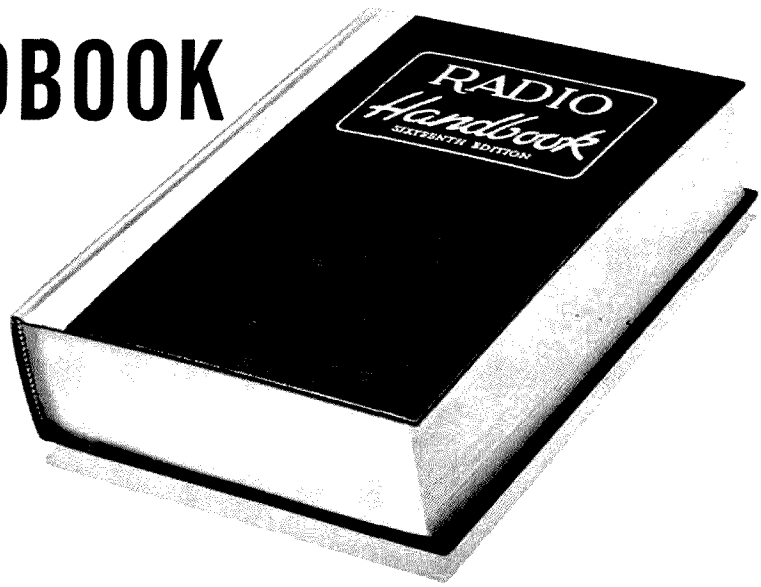
R1—560 ohms ½ watt.
R2—100,000 ohms ½ watt.
R3—33,000 ohms ½ watt.
R4—10,000 ohms ½ watt.
R5—3,000 ohms 5 watt.
C1, C2—25 mmf air trimmer (Hammarlund APC-25 or MAPC-25).
V1—12AU7A 9 pin min. tube.
V2—OC2 7 pin min. voltage regulator.



Rear view of cabinet showing opening cut for ventilation.

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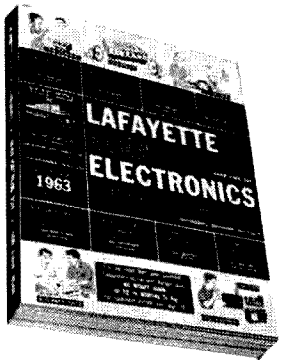
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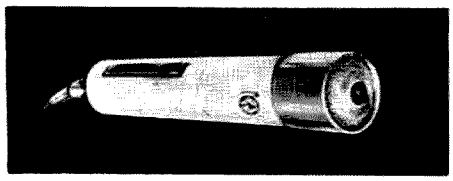
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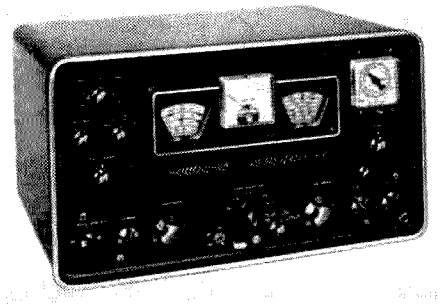
1963

Lafayette Radio, one of our strong boosters, is rushing the season with their new catalog. This represents quite a bargain when you consider the cost per page is about $0.00007731958, if you figure that you are getting 388 pages (the largest they've ever put out) for your 3¢ post card. Lafayette has been going great guns in the ham field you know, which means they have all sorts of gear that you won't find sold by anyone else. Same thing with hi-fi. Lafayette Radio, 111 Jericho Tpk, Syosset, LINY.



Big Mike

Communications, Inc., has a new idea for us. They are now producing a combination microphone and transistorized preamplifier all in one unit. This mike gives really high output if you want it and will give results even with rigs that normally are on the low side modulationwise. Big Mike costs $29.95 and features a squeeze-to-talk bar, a magnetic hang up arrangement and adjustable controls for varying the tone and volume output. The mike is only 4½" long and 1½" in diameter. A mercury cell runs the transistorized amplifier for several months of normal operation. Big Mike is available from most dealers or write Communications Inc., 33 Danbury Rd., Wilton, Conn.



HQ-145X

You may have been sitting around taking it easy, but it is obvious that the boys up at Hammarlund have been burning the midnight oil. The latest invention is a modified HQ-145 receiver which has a single crystal controlled channel for any fixed frequency that you may want to be able to monitor without having to return the main tuning control. This will be of great interest to fellows who operate on net frequencies, MARS, CAP, or want to be able to get WWV or CHU at the push of a button. Hammarlund will send info., 460 West 34th Street, N.Y. 1.

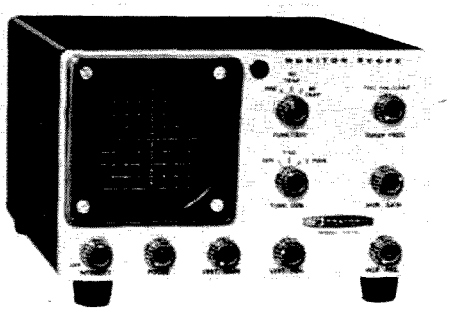


Reflected Power Meter

Heath now has a $15.95 SWR meter for your kit. Handles 1 k. ! Six through 160 meters. 50 or 70 ohm lines. Indicates the power rushing up your feeder toward the antenna and the power turned back by the mismatch when it gets there. May be left in the antenna system at all times. Designated model HM-11.

Telrex

Mike, W2BDS, has an all new PL77 catalog available. This one lists their myriad of different ham antennas and beams all in one little booklet, giving all of the particulars as to size, gain, front-to-back, beam width, weight, price, etc. Write Telrex, Asbury Park, N. J. and ask for one.



Monitor Scope

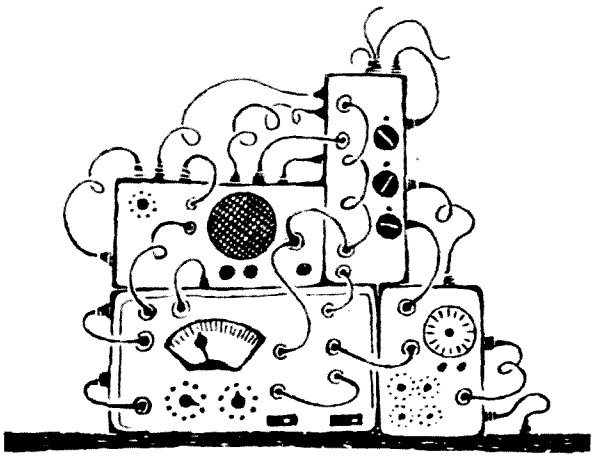
The new Heath Monitor Scope is specially designed for amateur use and displays envelope, af and rf trapezoid patterns, automatically switching between transmitter and receiver to give you the pattern for your own rig and the pattern for the received signal. 3″ scope tube. It even has a built-in two tone test oscillator for SSB rigs. Costs $59.95 in kit form. You can write Heath for info or watch their ads. Heath, Benton Harbor, Michigan.

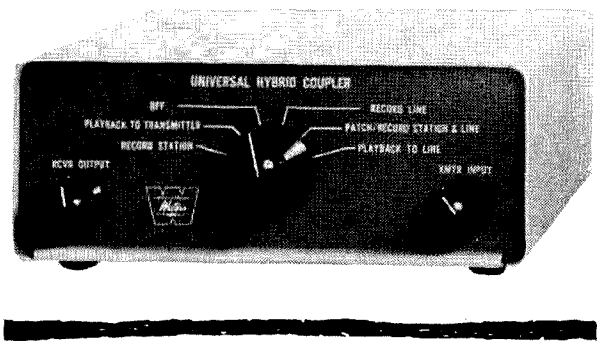
Signal Filter

Every now and then something that was designed for the CB market turns out to be a good thing for the ham, too. A case in point is the "Signal Filter" which is put out by Seco, a company well known now for their excellent test equipment. This gadget is a combination noise filter and squelch circuit using a triode and dual diode. It eliminates the hash from auto engines and other background noises. Many an amateur has been frustrated when he put a good VHF or SW converter in his car feeding into the regular car radio to find that all of the signals were drowned out by the engine and generator noises. This little $15.88 gadget will go a long way toward clearing up the interference. Drop a card to Seco, 1201 S. Clover Drive, Minneapolis 20, Minn. and say Joe sent you.

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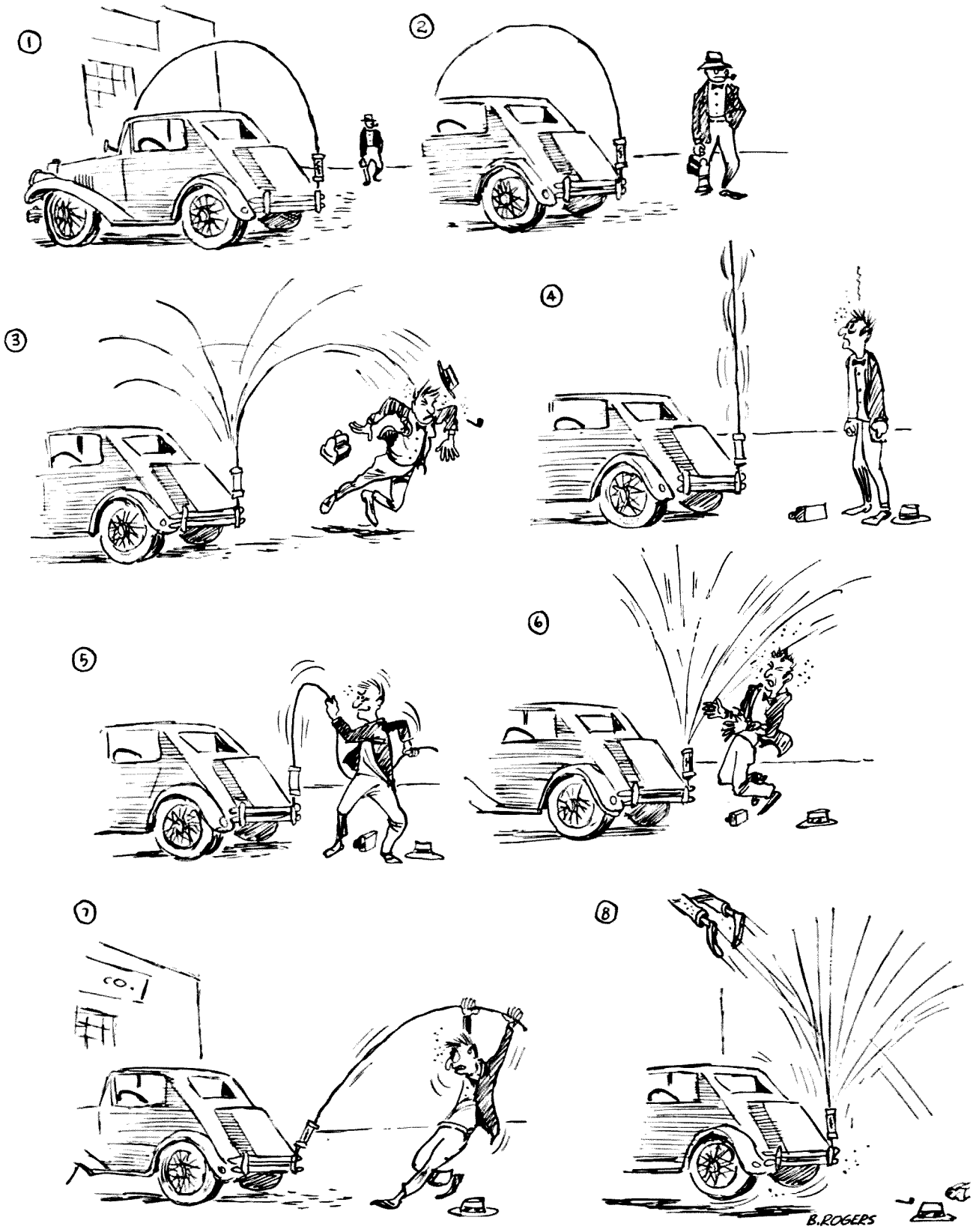
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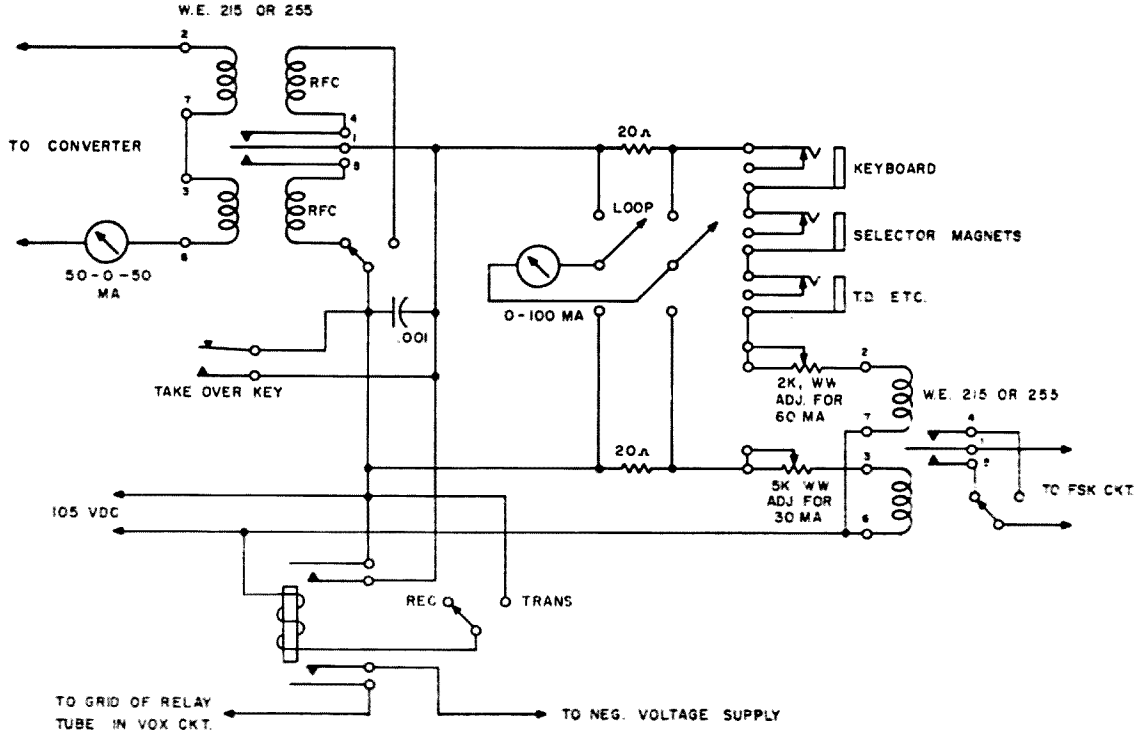
Control Circuit for RTTY

AFTER several years of experimenting with control circuits, I have arrived at one which seems to include all the operating features found desirable. It is simple, is not greatly different from those found published previously but includes features that I have found useful.

The addition of the "Take Over Key" provides for taking over when the copy starts piling up at the end of the line, is overlining or the machine is in upper case when it should be in lower. If any of these conditions exist, merely operate the "Take Over Key" then operate the proper keyboard keys to get the machine into proper condition to receive copy. The "Take Over Key" does not put the transmitter on the air.

Another feature of this control circuit that might be of interest to those who would like to control a transmitter using the VOX circuit is that of applying a negative voltage to the grid of the relay tube in the VOX circuit to provide the same control over the station they now have using VOX. Merely wrap a wire around the pin of the grid of the relay tube in the VOX circuit and the entire station is controlled by one switch.

. . . Lewis Stapp WØPHY



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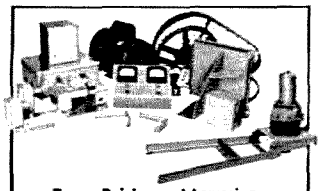
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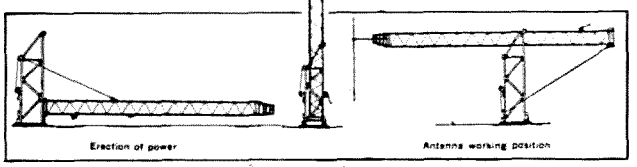
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Model RLRH-50

HEAVY DUTY SERIES

Model HDM-237	2 Section	37 feet
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Antenna working position

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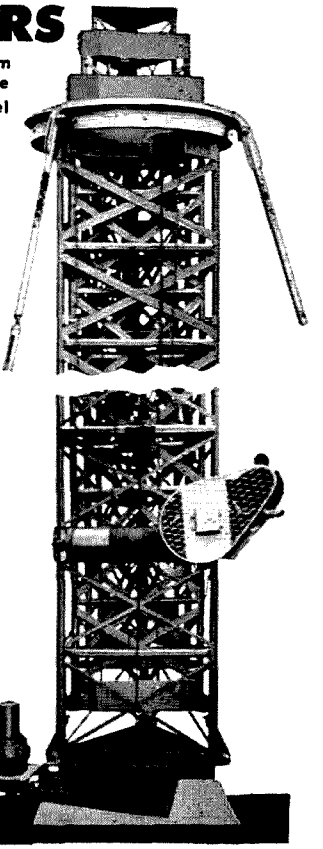
The new HZRN Rotating Tower is completely redesigned for smooth, frictionless rotating and raising and lowering. Featuring increased strength and greater weight, it meets and surpasses RETMA and UBC Building Standards.

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The tower is equipped with a 35 to 1 Timken roller bearing, sealed worm gear drive raising winch. You can motorize for full remote control with the aid of Tri-Ex accessories.

All HZRN Series towers are shipped complete with rotating base, 2 roller chain sprockets and drive chain, crank, and 3 concrete anchor rods and braces. Full engineering calculations and data are available upon request.

Model	Height	Weight
HZR-237N	37'	510 lbs.
HZR-354N	54'	805 lbs.
HZR-471N	71'	1235 lbs.



TRI-EX TOWER CORP. 2920 W. Magnolia, Burbank, California

Simplescope,

Part II

Fred Cupp K8AOE
Electronics Design Engineer
Clevite Ordnance Division of
Clevite Corporation
540 East 105th Street
Cleveland 8, Ohio

THE article on the Simplescope (73 Sept. 61) has refocused my attention on the ubject of high voltage–low current power upplies. The power supplies shown in the rticle are fine but. . . .

In the course of some development work on onar equipment, an interesting high voltage upply has come to light. It has one distinct dvantage over conventional supplies. The utput current will remain fairly constant over wide load variations. In most power supplies this condition is to be avoided. For scope use this can be a distinct advantage. In the event of a short circuit (either a component failure or the operator's hand) the voltage will drop under the increased load and maintain nearly constant current. That means insufficient current to kill!

The secret is the use of a series resonant circuit to step up the voltage. Fig. 1 shows

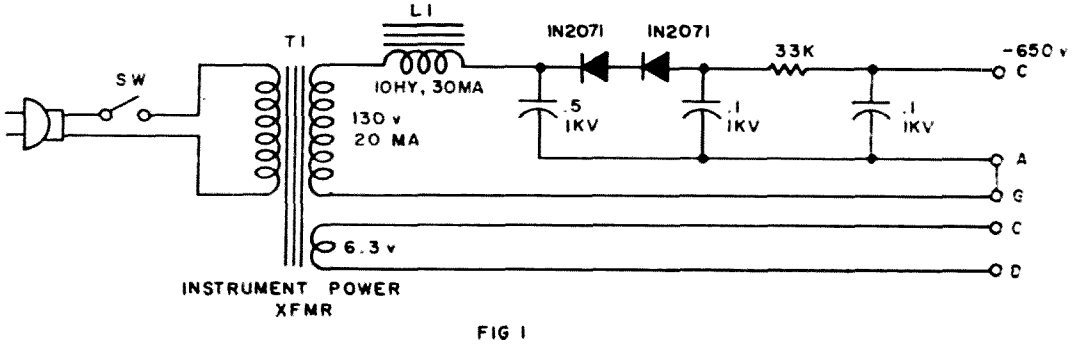


FIG 1

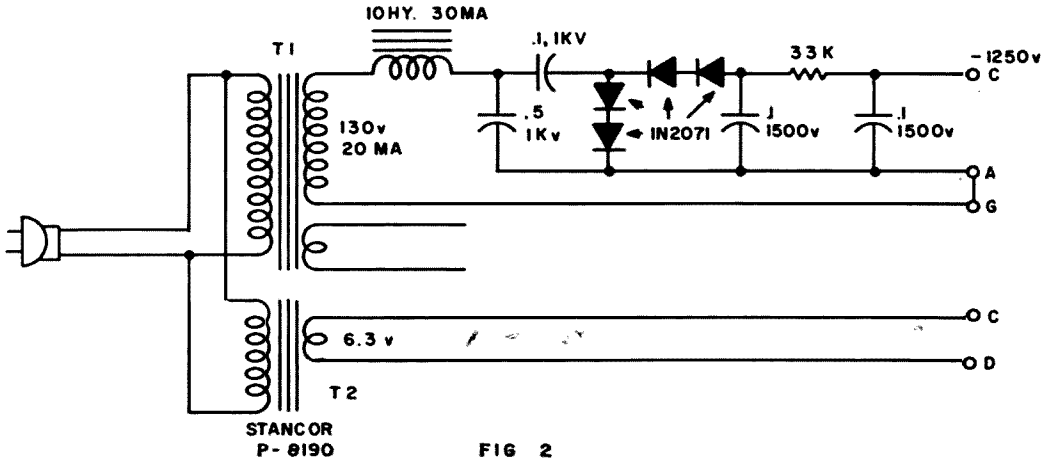


FIG 2

the schematic of the basic power supply. T1 is a common instrument type filament and isolation transformer. L1 is an ordinary 10 hy filter choke of about 30 ma rating. The choke and the .5 mfd capacitor to ground forms a series resonant tank at approximately 60 cycles. The voltage at the junction of the choke and capacitor runs as high as 900 volts RMS under no load. Under short circuit conditions, the choke limits the current to a low value, preventing either the operators hand or T1 from overheating. In this condition the tank circuit is no longer resonant hence no voltage step up.

The remainder of the power supply is a conventional half-wave rectifier which of course uses fewer parts than a voltage quadrupler. In addition the current limiting feature gives greater safety. By trimming the value of the series resonance capacitor the resonance may be shifted from 60 cycles, thereby changing the amount of step up and thus the output voltage.

In case you wish to build a de-luxe version of the simplescope, using one of the many 5 inch scope tubes available on the surplus market, the schematic of Fig. 2 may be used, with a voltage doubler rectifier. The output under typical load (a 5BP1 and its associated components) is approximately–1250 volts.

One further word of caution . . . With voltages as high as 1250 volts on the cathode of the CRT, I don't advise using the filament winding of T1 for the CRT. For the few extra dollars involved I recommend a separate filament transformer of sufficient insulation to stand the gaff. A stancor P-8190 will do nicely.

. . . K8AOE

Edgar Wagner G3BID
5, Ferncroft Avenue,
London, N.W.3. England

A Live and Working V-Beam

or Antenna Farming for the Smallholder

I HAD always wanted to have a little country cottage miles from anywhere; I had looked for one for a long time.

I wanted it near the sea; I wanted it to have a good view; and I wanted it fairly isolated.

Of course, it had to have a good site for an antenna farm as well.

So, when I went house-hunting, I took a portable rig.

At that time there was no mobile license in this country which meant that if the rig was mounted in a vehicle, the vehicle had to be stationary. Whenever we got to a likely cottage, I fixed up the rig generally stringing out some random length of wire to see whether we had a very high noise level and what conditions were like generally.

So, on the occasion when I first saw the cottage I subsequently bought, I fixed up the rig with a random length of wire and 25 watts, called CQ and a 'W' came back. We had a little QSO and signed, then another 'W' called me so this seemed quite a reasonable location.

Another look over the Band located SM5ARP—A very good friend of mine—in QSO with somebody else. I thought I would risk breaking in. He came back at once with a comment—"What are you using? Sounds like a kilowatt, that is above the legal limit in England surely?" But, when I told him this was a portable rig running 25 watts to a random length of wire, and that I was trying out the location for a cottage, the reply which came out of the loud speaker was—

"Buy it, Edgar, buy it; never mind the price, just buy it." Not wishing the price of the cottage to soar rapidly, I yanked out the loud speaker leads and ended that QSO.

So I got a site and a cottage. The piece of land I bought was not nearly large enough to put up V-beams, but as I got to know my neighbour better I discovered they had no objection to my putting a few poles on their land and so—Project V-Beam began.

A pair of wires were strung up on a pole and taken out into the field, just pegged into the ground, without any poles at the far end at all. Even in this way the results were excellent, and so the project grew.

Today I have a telephone pole by the cottage from which radiate six long wires at 45 degrees, one to the other, 275 ft. long. The pole at the apex is the highest and the others are fairly small thin poles so the V-beam slopes downhill a little like the ribs of an umbrella. At 275 ft. long and a 45 degrees angle they are about right for 15-meters, a little too wide for 10 and a little too narrow for 20 but they work beautifully as a compromise on all three Bands. On 80-meters if I take alternate wires I get a 90 degrees V-beam, 1 wavelength long, which is about right. On 40-meters they should not work at all but the joke is they do.

So, W2RWJ can rejoice to think that the V-beam is not only a nostalgic memory but a real live working V-beam, giving me a lot of pleasure. Perhaps I should add, the original reason why I decided to put these beams up was influenced, at least partly, by the fact that my nice isolated location by the sea is exposed to such violent gales that I do not relish the prospect of any form of rotary. These long wire antennas stand up to the gales remarkably well. . . . G3BID

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UG-175/U	11¢ each;	10 for $1.00;	10 for $1.25
UG-176/U	11¢ each;	10 for $1.00;	10 for $1.25
UG-173/U*	9¢ each;	12 for $1.00;	12 for $1.25
M-359*	23¢ each;	5 for $1.00;	5 for $1.25

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Metallic Rectifiers—

Simplified Circuitry

William Tancig K9MYZ
Rt 1
Beecher, Illinois

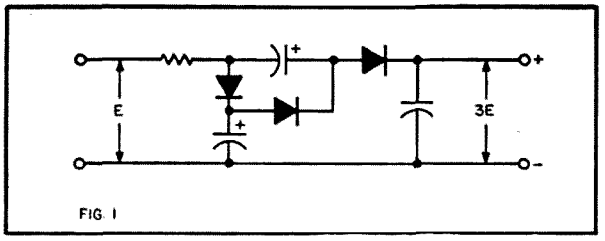


FIG. 1

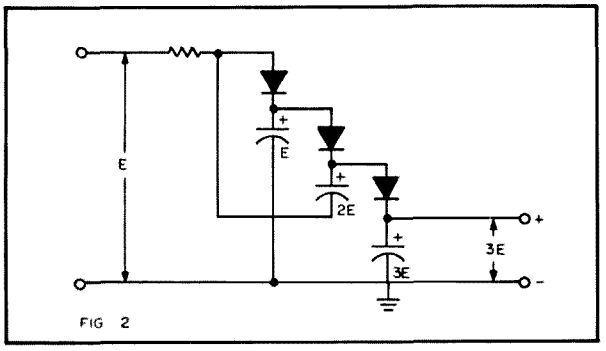


FIG. 2

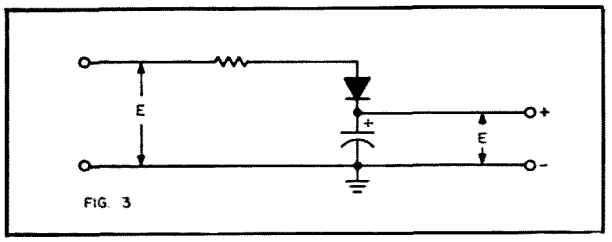


FIG. 3

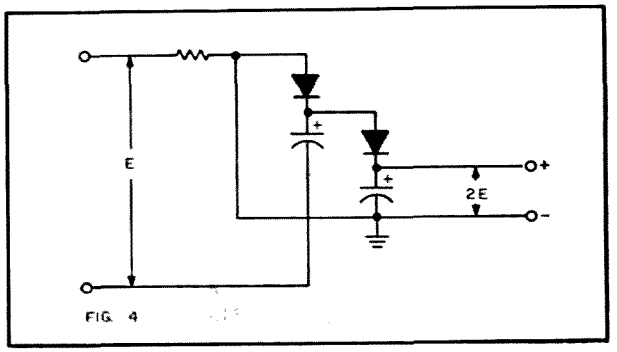


FIG. 4

FOR all of us who go around lashing up the odds and ends of ham-gear on a shoestring, the building of an adequate power supply can be quite a problem. Many is the project which has come to an inglorious end because someone specified a fifteen or twenty dollar power transformer.

During the last year or two I have been intrigued with the many possibilities for constructing power supplies based on silicon rectifiers. Quite a number have been built, and most have operated to perfection. The numerous advantages of metallic rectifiers have been recounted by others, and need no repeating here.

I suspect one thing which may be limiting the use of these rectifiers, at least by amateurs, is the nearly non-sensical way their circuits are drawn. Fig. 1 is a half-wave tripler circuit in the traditional manner. An expert can follow the machinations of the voltage, with some effort . . . but the rest of us. . . .?

Fig. 1 has been redrawn in Fig. 2 in what is more nearly a self-explanatory diagram. The circuit operation is much easier to follow, or deduce, and unthought of variations in the resultant circuitry immediately begin to suggest themselves. By looking at it as a "cascade," the repetition necessary for additional stages soon becomes obvious.

The simplest half-wave rectifier circuit is shown in Fig. 3, with a multiplier of 1. Fig. 4 has a multiplier of 2 . . . a half-wave doubler. From this point on additional circuits follow in arithmetical progression by simple cascading, and alternating return of the negative side of the final capacitor to one side or the other of

the supply voltage. The quickest way to become familiar with this system is to draw each one a number of times.

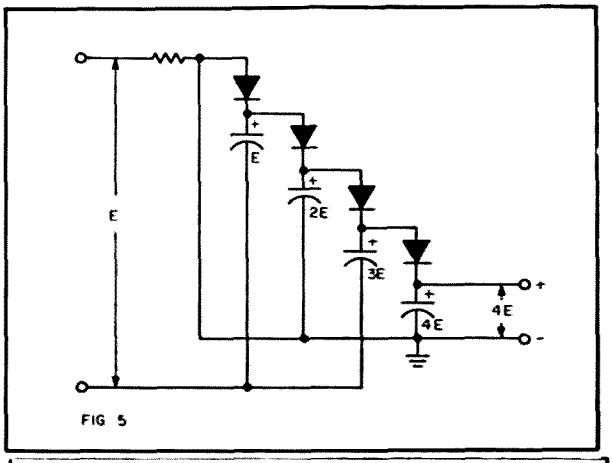


FIG 5

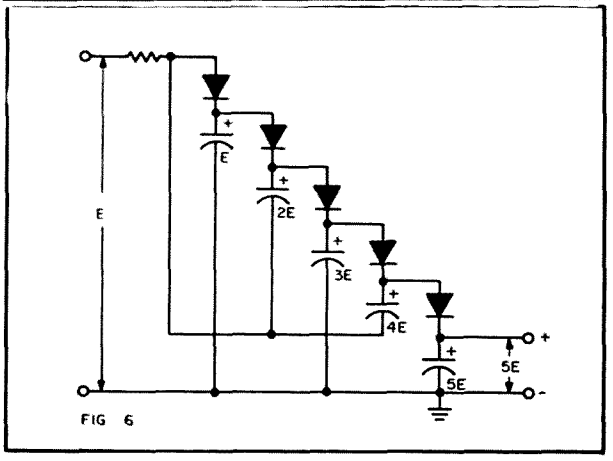


FIG 6

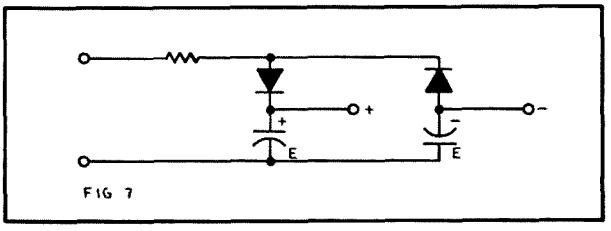


FIG 7

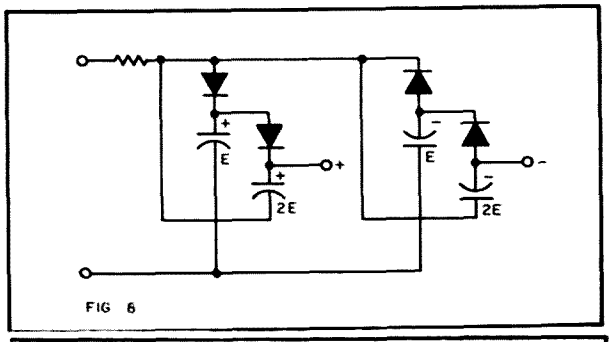


FIG 8

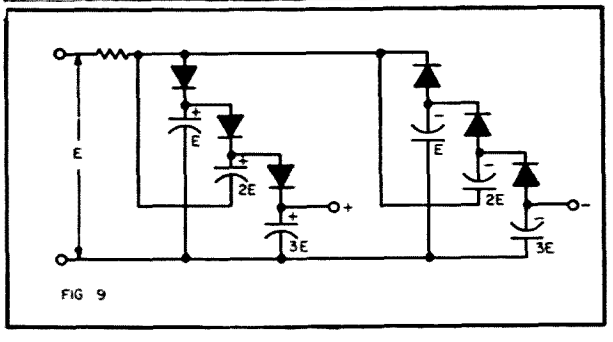


FIG 9

Fig. 5 and 6 show the corresponding quadrupler and pentupler. With almost no effort the cascades can be correctly drawn until one runs out of paper. Unfortunately, as shown in Fig. 2, 5, and 6, as the cascades increase, so must the corresponding capacitors' voltage rating. Some development by manufacturers at this point would make the use of metallic rectifiers even more favorable. The rectifiers, conversely, are all of the same voltage rating, being only large enough for a multiplier of 1. Because of the capacitor problem I have found it best not to plan on using these rectifiers for applications above 1000 volts. At least, it seems to me, that any dollar advantage in their favor begins to level out beyond that stage.

Fig. 7 is the familiar full-wave doubler composed of two half-wave cascades opposing each other. This circuit is particularly useful, but does suffer from the peculiarity that neither side of the output is common with the supply voltage. An isolation transformer is desirable here, but not absolutely necessary.

Fig. 8 is the analogous full-wave quadrupler and, again, the cascades can be placed in unending opposal to yield full-wave multiplication. Fig. 9 is full-wave with a multiplier of six.

These full-wave circuits, in addition to improved rectification have one additional advantage over the half-wave circuits—their corresponding capacitors, for double the voltage, are only half as large. Unfortunately, with the full-wave circuits, it is not possible to obtain odd multipliers.

In Fig. 10 I have modified Fig. 6 by indicating where various voltages may be picked off the rectifiers. These are easily deduced by following the cascade diagram. It is important to note that each circuit has two negative voltage sources, and they are not common. Nevertheless, this is a convenient manner to obtain lower voltages.

Fig. 11 illustrates a typical half-wave doubler circuit, complete with filter and bleeder, and Fig. 12 describes the corresponding pentupler.

In constructing such a supply the first question one must face is the matter of half-wave rectification versus full-wave rectification. Personally, I'm a half-wave man myself, and I have yet to find a receiver or transmitter that suffers from use of a half-wave rectifier as long as its output is well filtered. There are a number of theoretical objections, but these are not overwhelming in practice.

As one goes to voltages above 600 volts it

becomes necessary to use electrolytic capacitors in series which, of course, cuts their capacitance in half. Simultaneously, one must parallel each of the capacitors with equal sized resistors large enough to carry the required current. Normally each resistor should have a resistance approximately equal to the volts being born by the capacitor multiplied by 100.

Where circuits of this sort are utilized, particularly the half-wave type, it is nearly mandatory to use a polarized plug on the supply line. This is a good practice that many European countries adopted years ago. Forgetting this little detail means that sooner or later your eyeballs will light up, briefly, like a neon tube, and your muscles develop a nasty twitch.

And, in conclusion, don't leave out the limiting resistors. In the event of incorrect wiring they will keep the rectifiers from going up in smoke. . . . K9MYZ

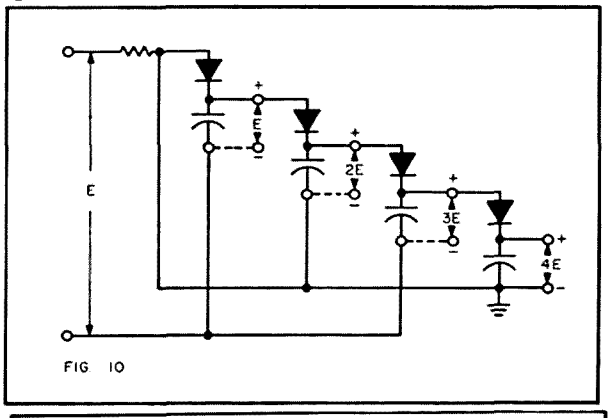


FIG 10

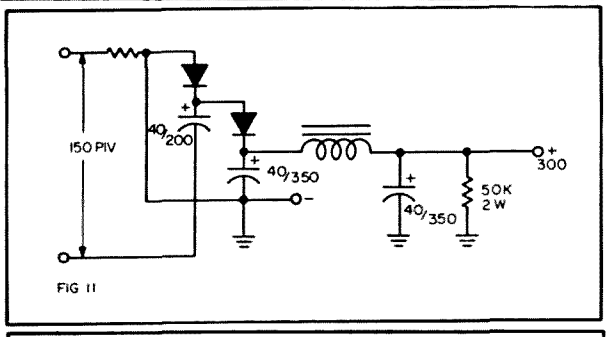


FIG 11

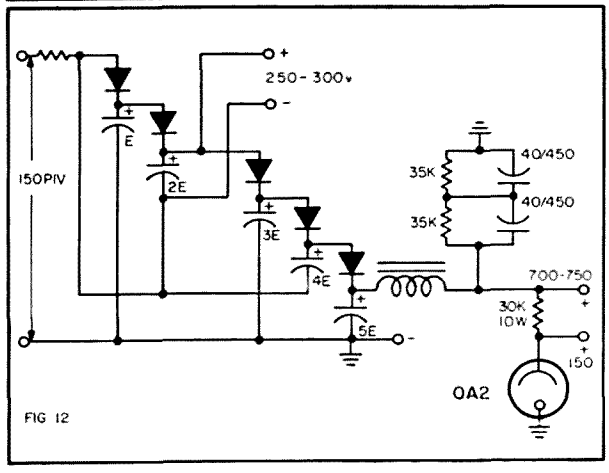


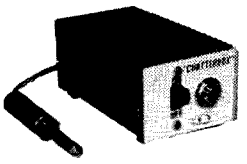
FIG 12

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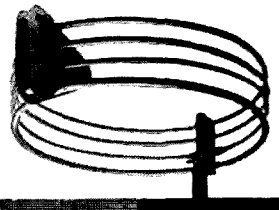
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PROBABLY the most striking thing about amateur radio literature today is the absence, in the main, of the experimental thrills the early days provided. All of the experiments we tried did not work, but we learned something from the failures, too. The modern trend towards the use of manufactured gear has been lamented by many, and construction articles are enjoying a comeback resembling pre-WWII days. Unfortunately much of the construction described resembles a kit enterprise, less the now familiar (S) and (NS) symbols and that manufactured look. I often wonder how many transmitters, receivers or gadgets are actually built from these articles in the periodicals, and from inquiry come to the conclusion that the chief enjoyment consists of an arm chair exercise reflecting upon the absence of critical components in an ever growing junk box. Ho hum! "Maybe the next issue will have something simple that I need and have the parts for."

Let me hasten to say that there is some darn good engineering in manufactured gear, kits and the construction articles. They all have their place, and the experienced experimenter makes good use of such equipment, both as reliable standards and to keep up with the gossip on the air. He does his experimenting outside of, or in conjunction with these standards. The proof of the pudding for any new equipment is in comparison with other equipment.

Some people think that it takes lots of expensive test equipment to develop anything new. The lab approach is not necessary, fortunately, for much that needs being done in amateur radio. Many of us have pet ideas tucked away, workable in thought but never produced Perhaps we are waiting for a vacation to work on them, had idle thoughts about patents or production, or even for an article for 73, but time slides by and nothing is done about it. Once in a great while someone really makes what you had been thinking of, and you see *your* idea in print.

If you are not going to do something about those ideas, why not pass them on to your fellow hams? Doesn't it make you mad to reflect that most of our antennas are no better than they were twenty five years ago? In fact most people used phased arrays and rhombics that far back, which were superior to todays almost universally used yagis. Today's excuse is urbanization—lack of space. But look at our mobile antennas. Can you conceive of anything poorer than a condensed whip? Antennas provide a fertile field for imagination, and a few ideas for *your* experimentation would not be remiss here.

How about that broad "40 db over" signal that takes up twenty kilocycles on your receiver dial. "Turn your gain down," snarls you. Strange as the thought may be to many hams, this could be a fault of your receiver, or receiving, even though you have an Umpty Ump 31 with a 500 cycle filter. Remember TVI and front end blocking? This could be happening to you. How about giving your receiver a decent chance by using a loop on the front end, nulling out interfering stations? Might have to put it on the chimney, with a small TV rotator. The signal loss could be built back with a nuvistor pre-amp up there. Antennas and nuvistors get top billing in the ham magazines. Any takers to build one and write about it?

How about your trap tri-bander now that ten is slated to go? Can't the old tower or

rotator take a 40 meter job in addition to the rest of the load? Hate to leave the local gang on ten? There are several ways to add a 40 meter capability to your system. The simplest is to make your dipole element resonant on 7 megacycles so that you have, at least, a rotating dipole. This could be done without disturbing the rest of the setup. One way is to load the center with an inductance. Not too efficient, yet the basis for "minibeams," and relays could do the feedline and inductance switching trick. How about adding another pair of traps? Good idea, but what about the turning radius? Well, remember the old pre-war Plumber's Delight? With the drooping elements? If an eighth wave or less is bent down at right angles from the new traps at each end of the radiator, no greater radius results and it is darn near as effective as a full length dipole. How about *your* building this one on any sunny Saturday afternoon?

What about that mobile whip? Vertically polarized too, isn't it. And a monstrosity at full length on 20 meters. Well, what about the car as a radiator. It is horizontal. Too short for twenty, sez you, and how do you feed it? Remember the folded dipole? And the Plumber's Delight? And that car you did not trade in on a compact? Figure the length of the car, assuming you have a good electrical contact from bumper to bumper. If there is any appreciable resistance, run a bonding braid from front to rear, grounding it at intervals. (A good idea even with conventional antennas!) No antenna insulators are needed in this setup; clamp vertical tubing front and rear as in the sketch to increase the electrical length for resonance on the band you want. Due to the large metallic body, less than the usual wire length should do. Take some RG-8/U and remove the outer braid. This braid could be your bonding material. Connect the unsheathed 8U to the top of each tubing mast, running it under the car. Cut it in the center, which will be your feed point. You might need a balun. Run the feedline directly into the car at this point, keeping it insulated. Your antenna system should now be horizontally polarized. Good idea? Try it!

This is imagination, the experimental stuff ham radio is made of. It is possible to go on and on with these ideas, with a bit taken from here and a bit from there. Why don't *I* try them, sez you? Well, it's raining outside, and this armchair is pretty comfortable. My junk box is pretty low too, all I've got is RG-58/U in it. Pretty light. Maybe I'll wait for a kit.

. . . W4API

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Hank Pettigrew, K400C, 73 Magazine, Peterborough, N. H.

The forthcoming Sunspot Low will cause a major problem in the use of the HF spectrum. Now is the time to give some serious consideration to make the best possible use of these bands.

On the Use of the Amateur Bands

S. P. Ted Wilds KZ5SW
Box 2519
Balboa, Canal Zone

SINCE the last time the sunspot cycle hit rock bottom, two significant changes have occurred on the amateur bands. The first is the major swing to phone operation, particularly SSB operation. The second is the vast increase in the number of US amateurs on the air. A recent survey shows that CW operation has dropped below 40% of all operation in the United States. We have in the neighborhood a quarter of a million hams who have a diversified interest in the use of the available frequencies assigned to us. A goodly segment of the group are primarily interested in reasonably long-range communication, be it for rag-chewing, DX chasing, or the handling of traffic. We also have smaller groups interested in VHF, TV, SHF, and experimental work. There are also the Ten Meter Buffs who will stay on 10, no matter what. Also to be counted are the Mobile gang, the QRP boys, the RTTYers, and other small segments (small per-centage wise) who will be adversely affected by the loss of 10, 15, and 20 meters. The big majority of amateurs who now operate on the HF bands will be SEVERELY affected.

When one considers that we have a theoretical allocation of only 800 kc of spectrum on the 40 and 80 meter bands that can be considered reasonably reliable for communication for the period of 1963 thru 1968, it becomes very necessary to make plans now so that these few kc can be used in the best interest of the fraternity as a whole. A study of the current situation as it exists on 80, 40, and 20 shows a condition that approaches the chaotic. As the considerable group now using 10 and 15 drop to 20 and then join the current 20 meter gang in a procession to 40 and 80, in ever increasing numbers, the QRM level, already bad, will become ear-splitting. The days of the Kilowatt Rock-Crusher getting thru anything in its way have given way to the battle of the many KW's fighting for air space. I believe that drastic action will be necessary to preserve some semblance of reality. Drastic action is always controversial. Keeping in mind that there are many sides to any controversy, I would like to make a few suggestions as to what I believe would ease the bedlam that we are currently headed toward.

First, it seems to me, we can no longer afford the luxury of special interest band subsections such as Novice, AM DX listening areas, SSB DX "allocations," phone-patch alleys and the like. I refer especially to 21.100-21.250, 14.100 to 14.200, and the "top 15" on twenty meters. Protected territory for the Novice on 40 and 80 is unrealistic. It just does not make sense to leave any usable frequency that is open to amateur radio by international treaty largely unused by the nation with the world's largest ham population.

Secondly, it seems to me that the segmenting of the phone bands, by custom, with the current acrimony between AM and SSB, will eventually solve itself with the gradual demise of AM, because it will be unable to compete for frequency space with the more potent, and narrower SSB. In the meanwhile, the phone segments, which must be expanded, should be more or less split according to usage of the two modes with AM taking entirely to one end of the band and SSB to the other, not by FCC action, but by ham agreement with NO dividing line between the two modes.

Thirdly, I believe that RTTY has a right to exist. Because this mode is not compatible

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with either CW or any type of phone at the current state of the art, due consideration should be made by the hams, not the FCC, so as to set aside a few kc in each of the 80, 40, and 20 meter bands for the use of RTTY.

Fourthly, the law-abiding majority must have a great deal more protection from the band-hogs that have been infesting the phone bands in recent years. These Class A lids include the super-power creeps running way beyond the legal limit, the crank-up-the-gain-and-scream lunatics, the 200% modulation jerks, and the "FCC-assigned-this-channel-to-me-personally-so-get-the-heck-off" characters. This motley collection of low-lifes have one thing in common: a self-centered attitude of "Me Me Me Me Me first and to heck with any one else."

This type of operation must come to a screeching halt! The FCC apparently will have to enforce our regulations more effectively. The gentle wrist-slapping of the few offenders that have been written up in the amateur press has destroyed the old image of a forceful FCC. A pink QSL from a far off monitoring station used to be looked upon as a catastrophe! So now we read about an alledged ham who received *eighteen* citations and winds up with only a six *month* suspension! A return to strict enforcement and realistic penalties to the perennial violator is a must. Backing up the FCC Monitors, should be a large and active Official Observer Corps of the ARRL. These stations should pay more attention to the band-hogs than they are now doing. Their primary job in the past has been to check for out-of-band operation. OOs need now to be equipped to make band-width and splatter measurements and report this type of deficiency to the offending station. Most of all, we need a return to the days when Joe Ham took great pride in the signal that he presented for inspection by his fellows. There was precious little of this "but-I-can't-get-out-unless-I-have-the-gain-way-up" school of operation. The newcomers of today are not getting the thorough indoctrination that used to be instilled by his instructor on the weary road to 13 WPM.

Now let's examine each band and try to improve the over-all usage of it.

10 meters. The low end of this band is the last to drop out and the first to come back. A few hundred kilocycles here make a big difference. CW operation is very slight. RTTY is almost non-existent. The FCC should authorize phone operation down to 28.100. The use of beacon stations on 10 would be very useful, but are not now legal. The FCC should authorize 50 watt beacons above 29 mc. Slow-scan TV above 29 mc should also be authorized. To keep the high end active perhaps a band of 200 kc from 29.5 to 29.7 should be opened to Technician Class operators. Remember there are greedy eyes looking at 10 for more 5 watt channels. Hams *must* keep the band busy for the next five years!

15 meters. This band will have to absorb many of the low power boys from 10 meters for as long as it stays open. The CW section is sparsely settled. The QRM on the phone section is severe when conditions are good. The FCC should permit phone operation as low as 21.150 mc. There never has been much Novice operation above 21.150 and with deteriorating conditions 50 kc will be more than sufficient. RTTY channels should continue around 21.090.

20 meters. This band will stay in longer than 10 and 15 and will continue to be of major importance for most of the rest of the cycle except for the three worst years. The FCC should authorize phone operation as low as 14.100 mc. A special DX listening sub-section from 14.1 to 14.2 and the "top 15" are extravagant luxuries that we simply cannot afford! RTTY should have a group of channels around 14.090 by operating agreement. Competition on 20 will probably cause more hams to engage in antenna experimentation and may be responsible for new antenna concepts. There has not been a breakthrough of significance since the advent of the quad. It's time for the hams to come through with something new.

40 meters. This is perhaps the hardest band to make any concrete suggestions about for several reasons. The Short-Wave Broadcasting, booming in along with their associated jammers, are making hash of the band above 7.100 in most parts of the country. This will be THE DX band for quite a long period. It is a favorite CW band for many of the gang here and overseas. It is here that a 50-50 split of the available spectrum seems to be justified. BUT . . . what is a 50-50 split here? From early evening until long after mid-night 7100 to 7300 is a bedlam of propagandists of all persuasions. There is scarcely 50 usable kc. It would seem that phone operation should be permitted in any of the few holes that exist above 7.100. Novice operation on 40 is open to question. If it *is* to continue, it will have to put up with General Class QRM. A better move would be to open up 160 for Novice and leave the highly desirable 40 meter band for those who have learned the ropes. We simply do not have the space for the 5 WPM beginners under the current con-

ditions. RTTY needs some space around 7090 kc by gentlemen's agreement. The SSB/AM controversy will be resolved by the process of elimination. In the meantime, let AM fill from the top down and SSB from 7100 up, with no dividing line between the two.

75-80 meters. Here we have our largest group of amateur frequencies in the lower frequency range. Here also we have a large share of the forthcoming chaos. Many new comers to the band will not conform to the long, well established multi-sided roundtable type of operation that has been typical of this band since it was a Class A band. Many of these so-called "nets" have always been of a strictly local nature. In some areas these groups have moved to two or six meters with real success. 10 watts on VHF can do as well as a kw on 75 for a fifty mile area. Non-amateur QRM will be a factor on this band in the foreseeable future. Remember it is used by other services on a shared basis south of the U. S.

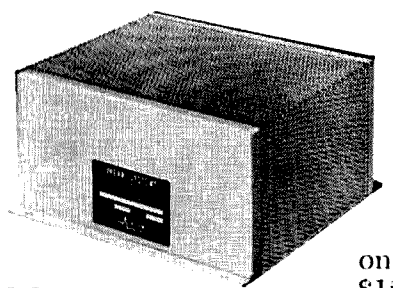
With phone operation up to 65% of total operation a more equitable split of spectrum space on this band is in order. Phone operation should be permitted from 3700 up. Novice operation should be moved to the 3600-3650 segment in order to keep their second harmonics inside amateur frequencies. There have been too many of our beginners getting citations for interference with other services. RTTY channels should be set aside by agreement on the low end or wherever a meeting point can be agreed upon. Until all phone carriers are suppressed, AM should carry on at the high end of the band, SSB expanding upward from 3700 kc.

160 meters. This band needs occupancy even though space is slim. It is highly desirable to open up a small segment in those states not now permitted to operate it. In other areas perhaps two sections of the band could be opened. There is current ARRL thinking along this line. If the band continues to be small segments, Novice CW should be encouraged. It always was a favorite beginners band. Low cost receivers work well here. Transmitters are very simple to get working well. In as much as few of the commercial rigs cover 160 any more, it would encourage the beginning home-brewer to get started "from scratch."

I realize that these are not the whole answers to many of the problems involved. The purpose of the piece is to stir up some thought on the subject by fellow amateurs and get them written up and put before the fraternity for disscussion and eventual action. Write

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down your own suggestions and send them to the amateur press and especially to YOUR ARRL DIRECTOR of Your Division. Changes will be made for better or worse. Let the careful consideration of the whole brotherhood of American Hamdom make them for the better. . . . KZ5SW

Other Ideas on the subject as picked up on the air.

1. Open all parts of all bands to all modes.
2. Limit power to 100 watts.
3. Allow 10 kw to Extra Class Operators.
4. Prohibit carriers for phone operation.
5. Restrict maximum band width to 3 kc for any type of transmission.
6. Return 40 to all CW operation.
7. Prohibit SSB.

Proposed Band Useage Chart

Band	CW	AM	SSB	RTTY
10	28.0-28.1	28.2 Up	28.1-28.2	28.090
15	21.00-21.150	21.150-Up	21.450 Down	21.090
20	14.00-14.100	14.100 Up	14.350 Down	14.090
40	7.00-7.100	7.300 Down	7.150 Up	7.090
80	3.50-3.700	4.000 Down	3.700 Up	3.690
160	Lower segment	*	*	*

*Other than A1 emission to depend upon expansion of this band.

During hours when DX is heard, strictly domestic QSO's are requested to leave 10 kc band edges to those working the DX stations. Novice: A1 on following sub-sections:

Lower segment of 160 meters
3600-3650,
21.100-21.150
53-54 Mc
Additional 10 Meter authorization
50W Beacon Stations (Aø, A1) and
Slow Scan TV above 29.000 mc.
Technician: 29.5-29.7

FCC Changes Required

Expand phone assignments to 28.1, 21.1, 14.1, 7.1, and 3.7 Mc.

Change Novice assignments on HF bands to 21.1-21.15, 3.6-3.65, and 160 Meters.

Expand 160 meters. Authorize Beacons and slow scan TV above 29 mc. Open 29.5-29.7 to Technician Class Amateurs.

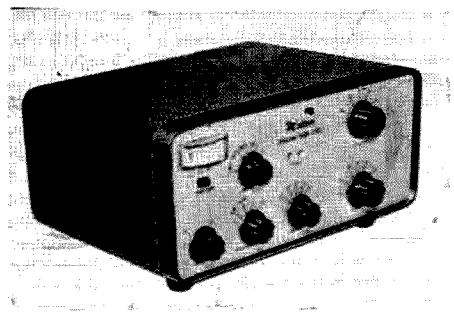
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More New Products



DSB

It is encouraging that World has been encouraged by the reaction to their DSB-100 to come out with a new double-sideband rig which covers all bands from 80 through 10 meters. This one, the SB-175, sells for under $100! It runs 100 watts AM, and 175 watts CW. The cathode-grid block keying gives a nice clean CW signal. This small unit will be popular for mobile work too since it is small and doesn't require any difficult bias voltages. Send for info to WRL, Council Bluffs, Iowa and mention that you read somewhere about it, you think.

Irving

Pappy, W5UB, has just brought out a new catalog which lists his 104 printed circuit boards which are in stock. Just about every ham magazine article which has used a P.C. board has been reproduced by Pappy. If you like to build at all you'll want to have this catalog at hand. Irving, Box 9222, San Antonio 4, Texas. Boards #8, 90, 103 and 104 are from 73, I see . . . maybe more.

WWV on the Drake 2-B

This popular ham band only receiver is sold with three crystals which gives full coverage of four of the amateur bands and 600 kc of the ten meter band. To receive any portion of any other band or bands requires the owner to purchase a crystal for the frequency he wishes to cover and to fill the crystal sockets for full coverage is rather expensive. Most hams want WWV for calibrating the receiver and for accurate time checks. 15 mc WWV time signals can be received on the 2-B without the purchasing of a new xtal or the need of shifting one of the present one's to a new position. Set the BAND SWITCH to the 40 meter position, and tune the PRESELECTOR to number 10. WWV will come in loud and clear at 0 on the logging scale. By sliding the glass on the dial

to exactly zero the dial scale is calibrated and will track amazingly close for all bands. It will be interesting to note that with the three xtals supplied with the 2-B, that bands can be copied in positions other than indicated; 80 meters also comes in on BAND A with the PRESELECTOR set on 4 position; 15 meters comes in on BAND 10 (2) with PRESELECTOR set on 8; and many foreign broadcast stations can be copied on BAND 20 with the PRESELECTOR set on 10.

It would be interesting to note the many different frequencies that could be copied at different settings of the receiver if all ten xtal slots were filled. Any one tried it?

. . . K4FQU

[W2NSD from page 4]

the end of September since this is after the regular tourist season and accommodations would be available and reasonable.

In the meanwhile, think about that inertia. Life swings along a lot faster and happier if you do things rather than just think about them. I know, it is hard to make that decision.

Earthshaking Inventions

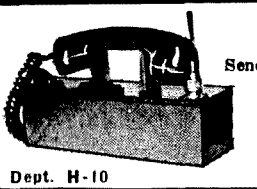
John Campbell, W2ZGU, being editor of Analog Science Fact and Fiction magazine,

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New Model 73 Announced!

Peterborough, New Hampshire, October 1, 1962. The publisher of 73 Magazine, an obscure publication for radio amateurs, announced today that starting with the January 1963 issue there will be a completely new model which will replace the old 1962 model 73. The publisher admitted, under close questioning, that the new model will probably be undistinguishable from the old except for the serial numbers. After a short fist-fight with the enraged and disappointed staff, the publisher, Wayne Green, who bills himself as "Never Say Die," triumphed and promised to do the same to anyone he found not subscribing to 73.

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73 Magazine PETERBOROUGH, NEW HAMPSHIRE

seems to learn about new inventions way before we read about them in the papers. He explained the Land color process to me months before I saw anything in print about it. John has come up with a couple more corkers that you may be interested in.

I've been holding off on mentioning one invention because I have been expecting to get a technical article or two on the subject. One of the main engineers involved turns out to be a ham, so we may eventually get some ham applications of the invention. The discovery is epochal. It is a simple system of binary coding voice frequencies. When you consider that Bell labs has spent many millions of dollars trying to do this, ending up with a huge, cumbersome system, you can perhaps appreciate the magnitude of this breakthrough.

What does this mean to us? Well, for one thing it means that we will eventually be able to cut our bandwidths down to about 150 cps for phone, allowing much greater use of our bands and the application of lower noise reception systems. Imagine how much room we would have on our bands if we could have 20 stations in the same frequency space now taken by one SSB station!

Won't this new system be too complicated for general amateur application? It doesn't look that way. The encoding device is about the size of a small salt shaker and the decoding device isn't much larger. Basically the encoder takes the third differential of the voice by means of three differentiating circuits. This removes all frequency changes entirely, leaving a monotone voice pattern similar to the speech of someone with an artificial larynx. This leaves a lot to be desired fidelity-wise, but it does make communication possible. The decoding circuit is a series of ringing circuits. Though patents have been issued on the system there is still some hesitancy on the part of the inventor to make too much information available. This is understandable.

This narrow bandwidth system would seem to have particular and immediate application to the moonbounce work now in progress. By the time you put this system together with the synchronous detection system Bill Ashby K2TKN described in September you should be able to get moonbounce into the ham shack and out of the laboratory. We have another little beaut coming up that not only will have application for all VHF'ers, but will be of particular application to the 1296 mc crowd. This is a system for stabilizing VFO's.

Breakthrough number two, and even more startling, was made by a young ham down Texas way. Pat Flanagan has a gadget he calls the Neurophone. This transmits radio waves directly to the brain, bypassing the audio nerve system entirely. I don't have to tell you what this will mean to deaf people . . . or to the earphone manufacturers! Plans are afoot to have an article on this one too. Pat says he does it by changing the waveform of the sound, which is quite logical since sound is detected and passed on to the brain with an entirely different system that we use for hi-fi. Details on this invention may be even harder to come by due to patent problems.

Open House

Sunday, August 19th was a beautiful bright day, one that displayed the Monadnock region of New Hampshire to good advantage. This is one of the most beautiful areas in the country, making it a wonderful drive for the visitors that poured in on us for our Open House celebration.

We had a hectic time getting ready for the event. It takes a lot of bustle to get things in even passable order in only six weeks, in the meanwhile continuing to publish our little magazine and other offshoot publications. Even so, by the time Sunday rolled around, we were set up with our offices operating rather smoothly, a fairly decent looking hamshack, a 100 foot tower with a tri-bander atop, a 64 element two meter beam ready to erect, and a two meter long-john up on a chimney.

The only fly in the ointment was that in the process I managed to worry myself to the point where my back (a weak point with me) gave out and I had to spend the day flat in bed unable to move one inch without searing pain. What an embarrassment!

Some 150 people turned up here, coming from as far away as Pennsylvania for the visit. It was quite a day. Kids were all over the place, tearing up the flowers, putting ten years onto my collection of toy Porsches from all over the world and feeding Virginia's horse hamburgers. Damned near killed the horse. One woman showed up with some of our flower pots and a trowel and was about to help herself to our flower bed, explaining that since Virginia is allergic to flowers we certainly wouldn't want them around. Another went through the house and attics picking out all of the priceless antiques that she liked, explaining that we weren't using them anyway.

CORRECTION

Our artist drew in an extra line which you'll have to remove from page 38 of the August issue. This was a small 6J6 converter for making an SWL receiver out of the 75A4 and other ham-band-only receivers. Strike out the connection between the top of L2 and C7. Move CR1 to between T1 and R6.

Virginia pointed out that though we would like her to have them, that they were the property of the Society For The Preservation of New England Antiquities and were part of the house, which used to be a museum.

We really had a good time and I hope that everyone who took the time and trouble to come over and say hello had one too.

Club

The ham flight to Europe, which we hope to have organized for next fall, requires that participants be a member of a club for at least six months before the trip. This means that we must have some sort of club affiliated with 73 in order to charter a plane.

One factor that has deterred me from rushing into the formation of a club is the possible reaction of the many League-oriented amateurs who might be alarmed, suspecting that I am trying to set up another League. This is not my intention. Perhaps I can put this matter in perspective with a short discussion of the League.

Many of the newer amateurs are not aware of the part that the League has played in the evolution of our hobby. While accuracy would perhaps be less strained if the A.R.R.L. were to blow their own horn, I'll try to generalize without too much distortion.

The American Radio Relay League, which has been with us throughout the lifetime of our hobby, has now grown to a multi-million dollar corporation that is largely involved with the publication of QST, the Handbook and dozens of other publications and products. Their yearly income is well over $1,000,000 and they have a tidy little fortune put away for a rainy day. They are following the time proven thrifty yankee tenet of never drawing on principle by financing their new headquarters building with donations from members.

In addition to the publications, which are a most important part of our hobby, the A.R.R.L. provides many services to the amateurs. These are important services and we would be hard put without many of them. The League provides a framework for the formation and running of ham clubs and encourages this participation with League Affiliation for clubs which qualify. A great deal of the strength of ham radio is derived from the thousands of ham clubs which are the backbone of our hobby.

The League furnishes a series of films and other programs to pep up club meetings, as well as interesting talks by League officials whenever practical. Their well organized traffic system covers the country with a well-knit set of nets which almost rivals Western Union. Many Brasspounders handle thousands of messages a month, year after year. This, the original purpose of the Relay League, is still a strong function.

The League for most of its existence has represented the amateurs before the FCC. Then, possibly due to pressures from the National Amateur Radio Council and other groups, came the sad day when the FCC decided to henceforth deal directly with the amateurs instead of through their League. Docket 9295 specified that the FCC would accept petitions for rule changes and comments on these proposed rule changes from any amateur, group or club and that their decision would be made on the basis of the facts presentd in the comments and petitions. The A.R.R.L. still represents us in the concept that they present comments to the FCC on each proposed rule change and they propose rule changes that are agreed upon by the Board of the A.R.R.L. There can be no question but that these well thought out opinions and suggestions must receive particularly careful consideration. So, in a sense, the League still is representing us.

The League has been generous with legal advice to harried amateurs beset with suits involving towers. TVI, and other battles with



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Year first licensed ..... Old calls .....

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local officials. Though they do not normally provide lawyers or financial assistance, they do provide invaluable help with all other legal assistance.

The League has been particularly outstanding in its leadership in the field of operating awards and certificates. The WAS, WAC, DXCC, RCC, and other awards are the standards in the hobby and much of our operating time is devoted to them. Our DX minded operators are completely submerged in the DXCC award and it governs ham events to an amazing degree. No other awards have achieved the stature of the A.R.R.L. certificates.

The League station W1AW has been sending code practice for many years and few amateurs have passed their license exam without spending quite a bit of time tuned to W1AW. The code proficiency certificates tie in with this program and have spurred many amateurs on to speed up their code ability.

The network of League appointed and elected officials throughout the country has done much to strengthen our hobby. The OO's (Official Observers) help police our bands, the SCM's (Section Communications Managers) encourage activity on a local level and report it each month in the fine print in the back of QST. The directors sound out the wishes of the amateurs in their divisions and act as representatives during the yearly meeting of the Board. All this is important and our hobby would be much weaker should we lack it.

I hope that I have perhaps put the League in perspective for some of the younger hams and that I have not glossed over or omitted any of the functions of the League enough to irritate the older members. It would be interesting to have a book giving the details on the development of ham radio and the League, which have grown hand in hand. Many fascinating events have taken place which have never seen the light of print and these should be chronicalled before they are lost with the deaths of the pioneers who made them happen.

At any rate, we are going to start our little club. It is not designed to take on any of the functions of the League, nor to fight the League. There are some things that we can eventually do which may help our hobby along in directions that are not now being pursued, should the members be interested. Charter membership in the club will be open for only for a short while.

Chartless

Well, the closest thing we had to a regular column seems to have demised. When the propagation charts arrived too late for inclusion in the August issue we waited for the thunder of complaints. Five letters straggled in, which wasn't very thunderous. I mentioned this situation in the editorial last month to see if this would bring forth any extra letters. One came.

This seems to back up my original idea that we should run articles and leave all the columns to QST and CQ. Should CQ drop their ham magazine and concentrate on their Citizens Band magazine we might consider filling the gap this would leave in certain phases of operating such as the World-Wide DX Contest and the Zone award, but we wouldn't go in for such things as SSB columns, Worked all Counties, and other dreadful unnecessaries.

73 Museum

Now that we have some room I can get started with an idea that has been brewing for several years: to have a museum of ham radio gear of the 30's. There are a couple of fine museums of earlier ham gear, but I don't know of anyone who is doing a job of saving samples of the equipment that was popular back in ham radios mid years.

The other day, while looking over the enormous collection of used ham gear at Evans

Radio in Concord, I found an old HRO under the bench, complete with coils, power supply and loud speaker. I grabbed it. This one turns out not only to be an HRO, but one of the first ever made, a plus in this acse. I was a little worried about getting a schematic for it, but on checking with National I found that they had a complete instruction book available for a one dollar service fee. As a matter of fact they apparently have books on almost every receiver they've ever made, each available for $1. In those rare instances where they can't supply the book they will send a schematic and parts list at no charge. They suggest you send order and forward the cash to them when they send the manual.

Now, about this museum. I'd like to have one each of the better known ham receivers from the 30's on display. If you have one kicking around that is in good shape drop me a line. I'm not really in shape to buy as yet, but I would like to have gear on loan or gift for display purposes, complete with a nice card indicating the donor or loanee.

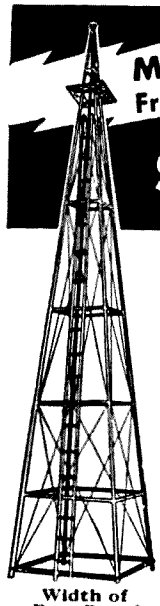
CB or Not CB

Quite a large part of my mail contains worries over CB and grumbles about the way it is being run by the FCC. I wonder what would happen if the FCC were to try out their license fee arrangement on the CB service? A fairly stiff license fee would separate the ranks a bit, leaving, I suspect, the fellows who have a more legitimate need for the service and culling out the fellows who have a more casual interest. I'm sure that the spectre of 1,000,000 CB'ers would fade quickly as would the increasing demands for more channels. This would make it a lot easier for the FCC to get in there and monitor the bands and further weed out the misusers of the license.

As I opined once before, I'm more in favor of the fellow who uses a service paying for it, rather than charging everyone for something just a few will benefit from. In this case the application is fitting. Everyone involved with CB on a legitimate basis would benefit from a license fee. The only fellows who would suffer would be those who don't have enough interest to pay the fee.

How much of a fee? Well, with equipment running around $100 for the average setup, I would suggest something on the order of $50 for a five year license. If it isn't worth that much to someone then he probably doesn't need the frequencies very badly. I don't think the CB magazines will like this helpful suggestion. . . . Wayne

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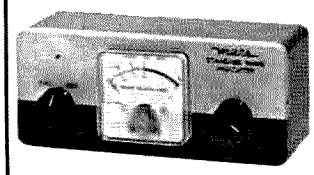
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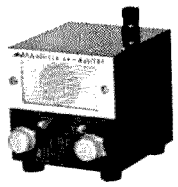
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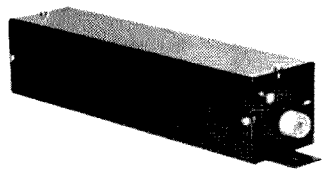
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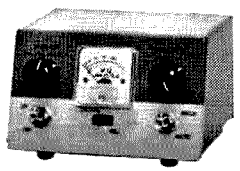
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The AN/ARC-2

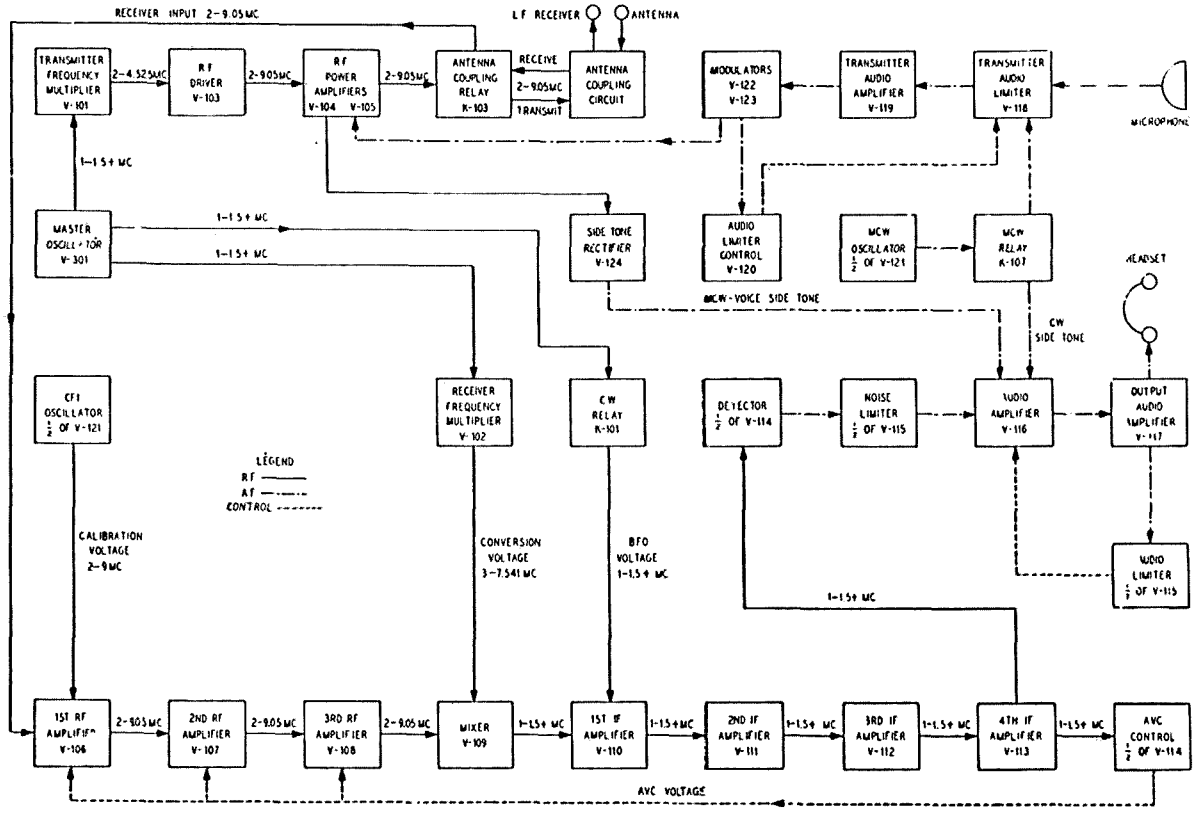
A Modern Transceiver in a World War II Package

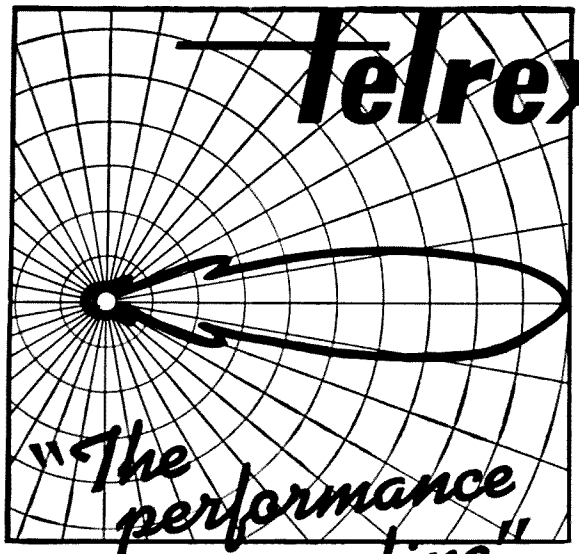
Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

A real sleeper on the electronic surplus market is the AN/ARC-2 Radio Set. The major component of this aircraft radio equipment is the Transmitter-Receiver RT-91/ARC-2 or RT-298/ARC-2A. This Collins Autotune transceiver covers the range of 2.00 to 9.05 megacycles in 4 bands and has a *rated* power *output* of 25 watts in the 80 and 40 meter bands. Provision is made for AM, CW and MCW operation. The equipment is housed in a black crackle finished case measuring 7¾" x 15½" x 21½" and weighs approximately 70 pounds with the dynamotor removed. While the proportions are not ideal, it makes a nice table-top package. The transceiver was designed to operate from the normal 28 volt dc aircraft supply and this presents the usual conversion problems.

The going surplus price of $40.00 to $50.00 makes this one of the true bargains on the surplus market. The AN/ARC-2, developed for the Navy late in World War II, incorporated techniques many years ahead of its time. True transceiver operation is obtained using a single Collins permeability tuned oscillator (PTO) which is employed in conjunction with a unique frequency deriving system.

The transceiver uses a total of 25 tubes and features many elements of the conversion techniques used in modern amateur equipment. The receiver and transmitter tuned circuits are all ganged to a single tuning control. Two additional tuning controls permit adjustment of transmitter loading and tuning of the antenna network. These controls are coupled to the familiar Collins Autotune mechanism





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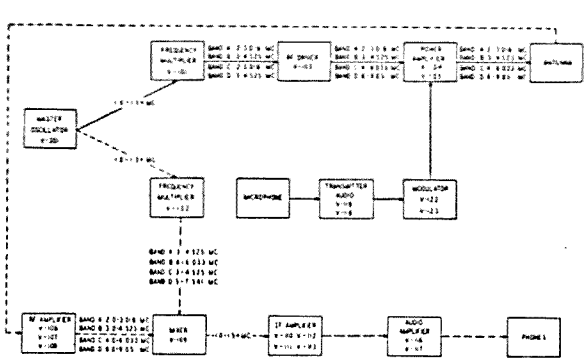
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which permits local or remote selection of any one of 8 preset frequencies. This motor driven tuning system may be disengaged and the controls manually operated.

A block diagram of the transceiver is shown in Fig. 1 and will aid in understanding the theory of operation. The frequency conversion scheme is shown in Fig. 2. The transmitter section of the equipment consists of an oscillator (a Collins 70E-1 PTO), a frequency multiplier, an rf driver and the power amplifier. In the two lower frequency bands, the rf driver operates as a straight amplifier and in the two higher bands as a frequency multiplier-amplifier. The rf driver feeds a pair of parallel connected 1625 tubes in the final. The PA tank circuit is inductively coupled to the antenna coupling network. This circuit permits resonating of the network with almost any random length antenna. A variometer is mechanically linked to a switch which selects a variety of LC combinations. The variometer rotates through its complete range for each switch position. This arrangement eliminates the requirement for one front panel control. A relay contact connects the antenna circuit to the receiver input in the receive condition.

The transmitter audio circuits consist of a double-bridge limiter with a control stage and a speech amplifier which drives a pair of 1625 as a class AB_1 modulator. Also included is an MCW-CFI oscillator. When MCW or AM operation is employed, a diode detector feeds a portion of the rectified output signal to the receiver audio input for monitoring purposes. In the CW mode, the modulator is disabled and the output of the MCW oscillator is applied directly to the receiver audio system. The audio input circuit includes a 300 to 3,000 cps band-pass filter. The audio limiter has little effect below 70% modulation but, at higher levels, effectively limits the modulation to below 100%.

The single conversion receiver employs 2 tuned and 1 untuned rf stages. The mixer stage develops an *if* frequency in the range of 1 to 1.5083 mc. The mixer injection signal is obtained from a frequency multiplier stage which is driven by the 70E-1 PTO unit. The result, as shown in Fig. 2, is that the *if* frequency is always identical to the HFO frequency. Oscillation and "birdies" are avoided by very extensive and effective shielding and filtering. Four *if* stages are used; 3 tuned and 1 untuned. These stages are slug tuned and are tracked with the tuning of the PTO, rf amplifiers, frequency multipliers and all transmitter stages through the PA plate. In all of these stages, except the PA plate, the tuning slugs are mounted on a platform which is

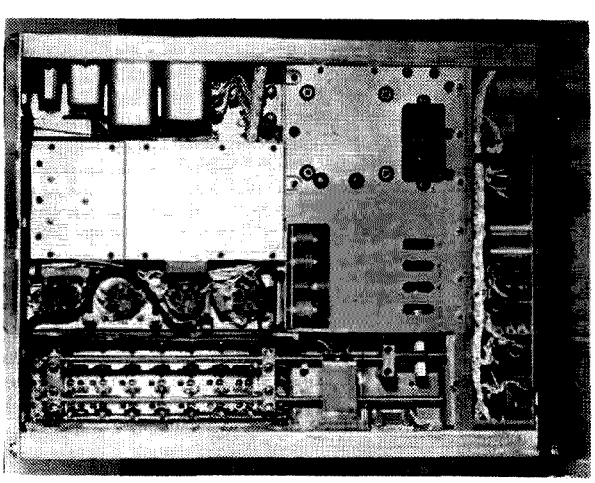


raised and lowered by the tuning control. The *if* signal is fed to the detector through a band-pass filter.

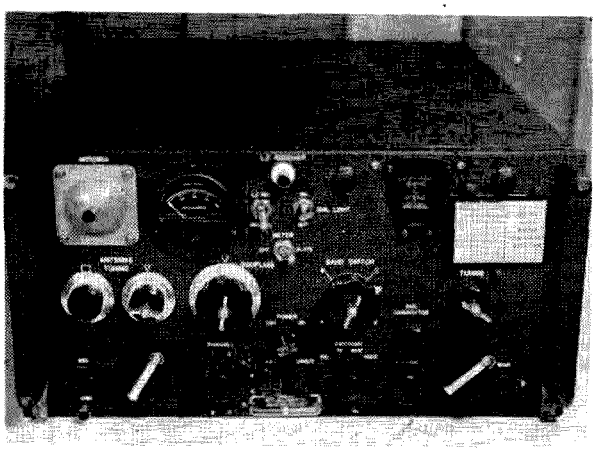
The second detector uses half a 12H6 with the second diode used as the AVC rectifier. A series type noise limiter uses half of another 12H6. This circuit feeds a 12SA7 limiter-audio amplifier. This stage drives a 12A6 tube to an audio output of half a watt into a 300 ohm load. An audio limiter rectifier samples the audio output and, when the voltage exceeds a predetermined level, a voltage is developed which is applied to the control grid of the 12SA7 audio stage. This limiting action maintains a fairly uniform audio output over a wide range of input levels. Audio and rf gain controls are ganged and varied simultaneously. A crystal calibrator circuit is provided which supplies signals at 100 kc intervals through the frequency range of the equipment. A front panel control permits the main tuning dial pointer to be accurately set at any 100 kc check point.

As shown in the photograph, the front panel is remarkably clean for an equipment as complex as the AN/ARC-2. This is achieved by mechanical ganging of controls and by the extensive use of relays. Front panel controls include main tuning, calibration corrector, band switch, volume, power switch, emission selector switch, Autotune channel selector switch, antenna coupling, antenna tuning and an auxiliary sensitivity control. In addition, dial light, meter and auxiliary receiver selector switches are provided. The meter and the antenna, microphone, key and phone connectors complete the front panel appearances.

The 28 volt DC aircraft supply is used to power the transceiver. Tube heaters, pilot lights, relays and microphone require approximately 4 amperes. The dynamotor draws about



The under-side of the AN/ARC-2 is not altered in this minimum conversion.



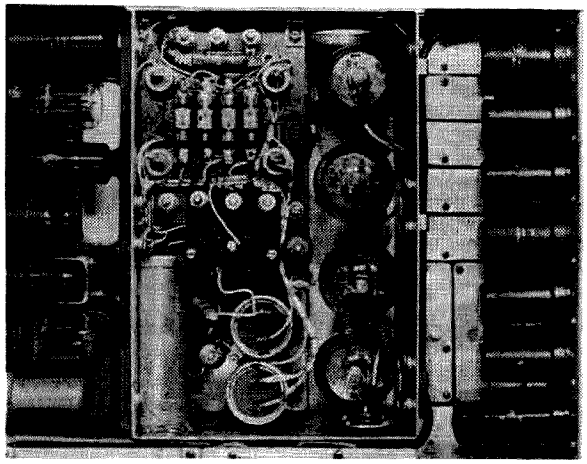
External view of the converted AN/ARC-2. There is no change in the external appearance of the unit when this minimum conversion with the self-contained power supply is accomplished.

12 amperes under load and the Autotune motor draws an additional 6 amperes. The dynamotor supplies 260 volts at 125 ma for the receiver and low power transmitter stages and 500 volts at 325 ma for the transmitter output stage and modulator.

If a heavy duty, 28 volt supply is available, the AN/ARC-2 is usable "as is" for amateur operation. However, the dynamotor noise and other problems recommend against such usage. Analysis of the circuit and wiring diagrams shows that this conversion falls logically into two phases. Removal of the dynamotor and minor wiring changes are required to permit operation from an ac line operated power supply. This supply may be completely external or may be partly, or even entirely, self contained. The second phase of the conversion makes wiring changes and adds certain features which make for more flexible amateur operation.

Although the relay control system requires a 28 volt dc supply, the current requirement is nominal. The schematic and wiring diagrams were searched in vain for an easy way to separate the relay, microphone and tube heater circuits. Since extensive rewiring would be necessary to accomplish this, it was decided to use a single 28 volt dc supply to meet all of these requirements. The low cost and ready availability of 3 and 5 ampere, stud mounted silicon rectifiers makes this by far the best and easiest solution to the problem.

The first step is to remove the unit from the case and this can be difficult if you are fortunate enough to get a new unit. The case is secured by 2 Dzus fasteners on the back of the case. In addition, the vent ports must be removed. If they cannot be unscrewed with the fingers, use the spanner wrench secured to



The bulk of this conversion is the AC power supply installed in the dynamotor compartment. The 24 volt bridge rectifier, the 300-600 volt doubler-quadrupler diodes and the fuse are all mounted on the transformer terminal board. The filter capacitors and other components are mounted as convenient.

the back of the case. The lip of the case is clamped to the front panel by finger stock so that a substantial pull is required to remove it.

Loosen the snap fasteners holding the dynamotor compartment cover in place and set it aside. Remove the 2 center 1625 tubes, loosen the dynamotor clamp screws and remove the dynamotor. The contoured dynamotor mounting bracket is spot welded to the deck and these welds must be broken loose. The simplest way is to cut the bracket lengthwise with an Adel nibbling tool. Take a pair of gas pliers and work each section back and forth until the welds break loose. It sounds messy but the welds break cleanly, out of the bracket, and leave small, inoffensive "buttons" on the deck. Remove the connector from the dynamotor and install it on the plug in the bottom of the compartment. Discard the dynamotor and reinstall the 1625 tubes.

The dynamotor compartment may be used to house power supply components and a space approximately 4½" x 4½" x 9½" is available for this purpose. The 28 volt dc supply shown in Fig. 3 may be wired as a sub-assembly and installed in the compartment. Switching and control is greatly simplified if this supply is allowed to run continuously. The current drain and heat dissipation of the supply should be negligible and should pose no problem. During extended periods of station inactivity, the unit may be unplugged or, if a station master switch is used, the problem does not exist

Although available surplus diodes and transformer were used in the unit shown in the photograph, the standard items specified in Fig. 3 will do the job nicely. Incidentally, the diodes shown have a sufficiently high rating to permit their mounting on the transformer terminal board without a heat sink. Lower rated diodes, such as those specified, will require the conventional treatment.

Install the assembly at the rear of the dynamotor compartment, locating it so as to occupy the minimum space. It may be necessary, depending on the mounting centers, to temporarily remove some components from under the chassis to drill the mounting holes. Drill a clearance hole in the deck to clear the 28 volt positive lead. Pass this lead through the hole and connect to Pins 1 and 17 of P-101, the main power connector. Clearance is limited and a "long reach" soldering gun tip will help in this operation. Connect the 28 volt supply negative lead to chassis ground and Pin 1 of the dynamotor connector. As shown in Fig. 3, an additional filter capacitor is required in the microphone circuit. Locate C-238, near the front of the right side of the unit, and connect a 250 mfd, 50 WV tubular electrolytic

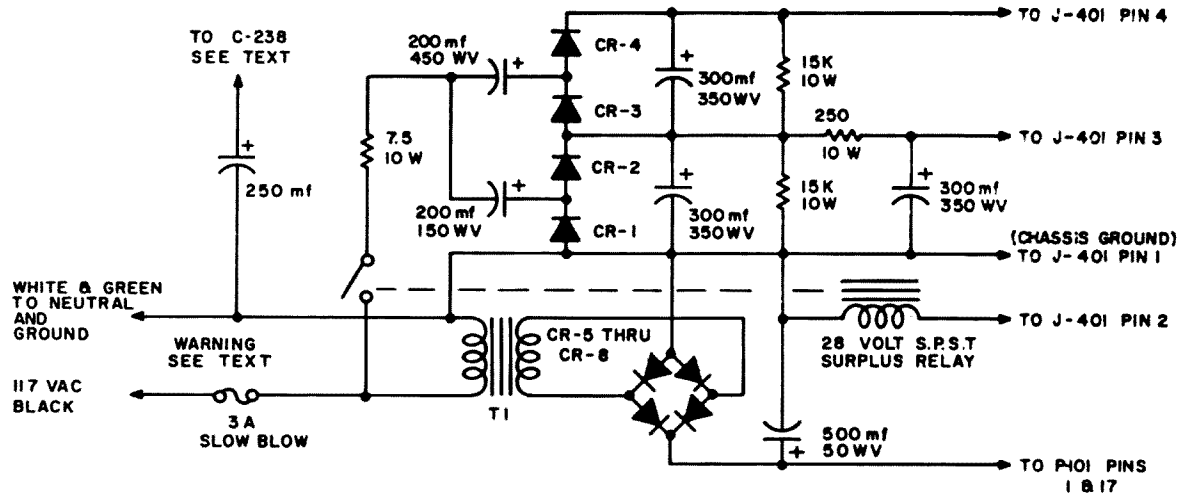
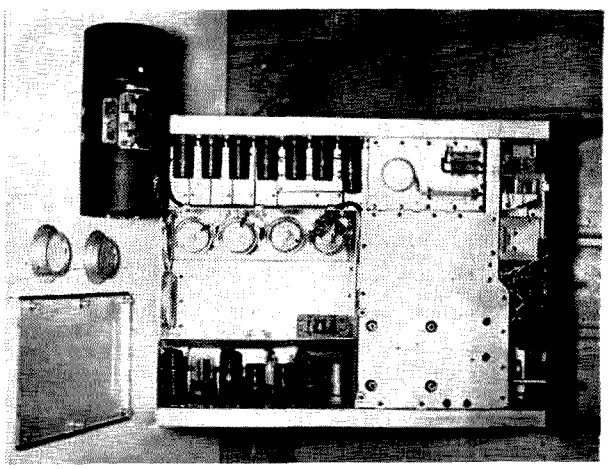


FIG 3

in parallel with the original capacitor. Dress the new part so that it will clear the case, using a clamp if required. Dress the ac cord out through one of the vent holes and the 28 volt supply is completed.

If the 3 ampere silicon diodes are used, the Autotune motor must be disabled. Disconnect the 4 motor leads from the terminal board above the motor and tie them out of the way. If the 6 ampere diodes are used, the Autotune feature is retained. While the Autotune motor imposes an overload in excess of 100% on the transformer specified, it is of very short duration and no damage to the transformer results.

Turn the front panel power switch to the off position and plug in the ac cord. Measure the 28 volt supply voltage which should read about 30 volts. Turn on the front panel power switch; relays should operate, the Autotune mechanism (if used) should cycle and all tubes should light. Voltage of the 28 volt supply, under heater and relay load, will run about 26 volts and the Autotune motor will cause an additional 3 or 4 volt drop.



Top view of the transceiver shows the dynamotor removed and the compartment ready for installation of the AC power supply.

If the Autotune feature is disabled and had previously been stopped during a cycle, it will be necessary to manually complete the cycle. A Bristol wrench will be found clipped to one of the top cover plates of the chassis. Leave power applied and insert the wrench in the end of the Autotune main drive shaft which is accessible through a hole adjacent to the previously mentioned capacitor, C-238. Rotate the shaft until you hear a relay operate. This completes an interlock circuit and will permit normal, manual tuning.

This completes the check-out of the low voltage supply and we are now ready for the two plate supplies. Regardless of whether external or self-contained supplies are used, it is

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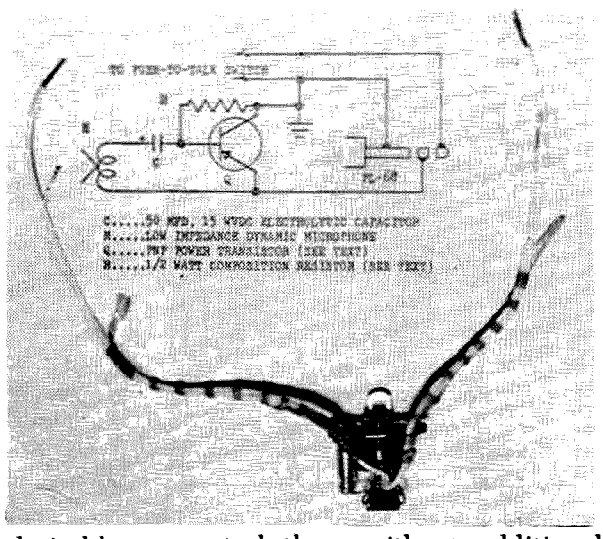
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desirable to control them without additional switching. The relay circuit shown in Fig. 3 provides this function. A surplus 28 volt power contactor is wired between Pin 2 of the dynamotor connector and ground, Pin 1. When the front panel switch is closed, this relay is operated and the contacts are used to supply AC power to the plate power supplies.

While the writer has the usual objections to line operated, transformerless power supplies, their use greatly simplifies this conversion and permits a completely self-contained package. If this approach is taken, use the new UL grounding type ac connector on a three conductor power cord and use only in a receptacle that has been verified as being properly wired with the ground connection carried through. In the event the plug is inserted in an improperly wired receptacle, the worst that can happen is a blown house fuse. In any event, play it safe. *Avoid haywire and adapters and be absolutely certain the chassis is at ground potential. BETTER BE SAFE THAN DEAD.*

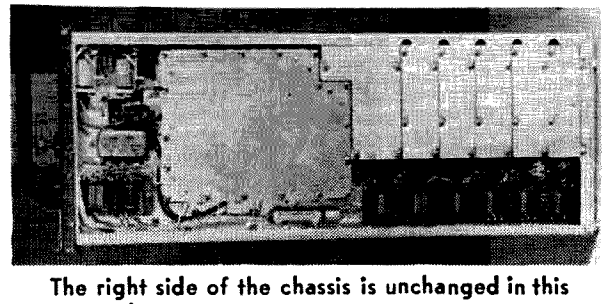
Install the plate power supply components in the compartment and wire in accordance with Fig. 3. No parts placement drawings are supplied since layout will depend on the components available. The photograph shows a practical arrangement. The fuse and all diodes are mounted on the 24 volt transformer terminal board. Over-rated power resistors were on hand and were used. The capacitors are supported by base clamps and are insulated with sections of plastic tubing. Keep in mind that you are dealing with over 600 volts dc and insulate accordingly. Don't skimp on the values of capacitors specified. The result will be poor regulation and high hum level. While the values shown are not available from all manufacturers, all units specified are available in the Pyramid line.

The power supply choice is an individual decision and if external, transformer type plate supplies are selected, connect the nominal 260 volt positive lead to Pin 3 and the nominal 500 volt positive lead to Pin 4 of the dynamotor connector. Use Pin 1 as the common ground. Lift the ground connection on the ac power line and feed the ac to the supplies through the contacts of the added relay.

Check out the wiring of the supplies and if all seems right, turn the front panel power switch off and connect the ac power. Turn the front panel switch on and measure the plate supply voltages. The line operated supply delivers about 270 and 610 volts in the receive and 260 and 580 volts in the transmit condition. Loosen the Autotune locking screws on the control knobs, connect an antenna and a pair of phones and we are ready to test the receiver.

Advance the screwdriver adjusted sensitivity control fully clockwise, turn the emission switch to the "Voice" position and advance the volume control. Tune across the bands and a multitude of signals should be heard. Turn the emission switch to the CW position; the BFO injection relay should operate and CW stations should be received. Throwing the switch to the calibrate position should turn on the 100 kc standard and remove the antenna. To calibrate the dial, tune to zero beat with the nearest 100 kc check point and adjust the corrector knob for precise dial calibration.

With the receiver checked out, we are now ready for dummy load testing of the transmitter. Connect a 150 watt lamp between the antenna post and ground. Plug in a key and throw the emission switch to CW. Close the key and observe the plate meter. If no plate current is noted, the antenna tuning control is probably set between taps, opening the transmitter interlock circuit. Turn this control until the relays close. Set the coupling control on 100 and tune through the 10 positions of the tuning coil switch, returning to the position that gives maximum lamp brilliance. Back off on the coupling control to keep the plate current below 200 ma. Full loading may not

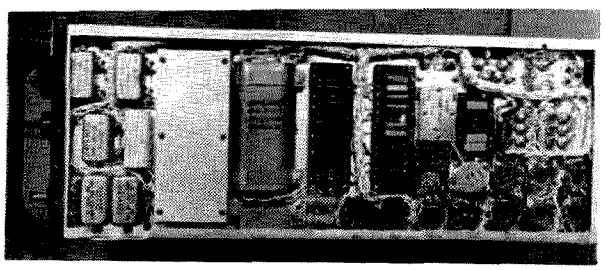


The right side of the chassis is unchanged in this conversion.

be obtainable across the 40 and 80 meter bands but more on this later. Tune in the signal on a local receiver and key the transmitter. Clean keying should be observed, accompanied by the relay clatter that is typical of military equipment.

Turn the emission switch to the AM position and plug in a carbon mike with the normal PL-68 termination. Close the push to talk switch and speak into the mike. Audio should be crisp and have the characteristic "punch" of a good compressor type audio system.

"On the air" testing is next on the agenda. As previously mentioned, the antenna network of the AN/ARC-2 is designed to match the characteristics of the usual aircraft antenna. While ideal for loading a random length of wire, some difficulty may be encountered in loading the conventional 50 or 70 ohm line.



The only change in the left side of the unit is the installation of the additional microphone supply filter capacitor shown in the top of the photo.

In any event, try it with your antenna. Set the coupling control to 100 and tune through the complete range of the tuning control, watching for maximum rise in PA plate current. Back off on the coupling control as required to keep the plate current below 200 ma. It is wise to confirm the settings of the antenna network by peaking the adjustments from "on the air" reports or with a field strength meter.

Autotune setup is simple and will permit the automatic selection of any 8 frequencies within the tuning range of the equipment. Good resetability, coupled with the stability of the PTO unit, make this feature ideal for quickly coming up on MARS and other net frequencies. Turn the Autotune selector switch to the desired channel and, after the drive cycle is completed, calibrate the set to the nearest 100 kc check point. Set the dial to the desired frequency and tighten the screws in the tuning and band switch knobs. Load the transmitter into the antenna as normal and then tighten the screws on the coupling and antenna tuning controls. Set up as many channels as desired, making sure the locking screws are tight before switching channels. Any position may be used for manual tuning

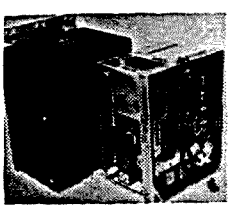
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by releasing the locking screws. DO NOT CHANGE THE AUTOTUNE CHANNEL SWITCH WITHOUT LOCKING THE CONTROLS OR PRESET DATA WILL BE LOST FOR ALL CHANNELS.

While no component failures have occurred in the prototype, the heat rise in the power supply-PA tube compartment may result in shortened life for the silicon diodes and electrolytic capacitors. If extended periods of operation are contemplated, it would probably be wise to provide forced cooling. A small blower, mounted over the right rear vent port would direct a flow of air over the 1625 tubes, around the power supply components and out the other port. This should result in adequate cooling and long component life.

Rubber mounting feet complete the conversion. Locate and drill clearance holes for the mounting screws about ⅜" from the sides of the case. Transfer these locations to the "U" shaped channels which are formed in the side chassis. Very carefully drill and tap these holes to accept the machine screws used to mount the feet. Extreme care is required to prevent damage to the cables in these channels.

Those who have not experienced the convenience of high stability transceiver operation are in for a pleasant surprise. Performance is excellent with good sensitivity and selectivity that is par for the course. A period of operation will give a feel for the equipment and will also point out possible areas of improvement. Various other modifications have been made to the prototype which, while fairly simple, require reference to the wiring and schematic diagrams. These drawings are available but would require at least 8 pages of 73 Magazine for barely adequate reproduction.

In order to hold this article to an acceptable length and still make the material available, arrangements have been made for publication of a separate booklet. The booklet consists of this article, wiring and schematic diagrams for both the AN/ARC-2 and AN/ARC-2A along with many additional photographs, diagrams and complete instructions for adding the following features to this conversion:

1. Self contained speaker and matching transformer wired to a "normal through" phone jack.
2. Removal of the existing ganged audio output attenuator and rf gain control and installation of a separate low level audio gain control.
3. Replacement of the existing sensitivity control with a front panel rf gain control.
4. Modification of the rf output coupling network to provide efficient operation into a 50-70 ohm load. The versatility of the original network is retained in this change.
5. Removal of the dial light switch and addition of an AGC switch.
6. Removal of the low frequency antenna switch and addition of a sidetone disable switch to permit speaker operation with AM.
7. Inclusion of a transistorized mike input amplifier unit to permit use with low impedance dynamic microphones.
8. Installation of improved break-in keying circuitry to permit higher speed keying and to reduce relay noise.

Both the minimum modification and the full treatment of the AN/ARC-2 result in high performance packages at a fraction of the cost of commercial gear. The stability and high standards of workmanship are difficult to obtain on today's market. The equipment is highly recommended as a complete station and as an auxiliary or emergency rig.

. . . W4WKM

FM Rejecting Stub

Earl Murphy W8HOA

RECENTLY a nearby FM station was put in operation and I discovered to my dismay that I was getting an overwhelming signal from them apparently in the middle of the six meter band. After some sleuthing I determined that the second harmonic of my converter oscillator was beating with the FM signal resulting in an output in the middle of the AM broadcast band where I was trying to listen to six meters. Not much could be done about the second harmonic of the oscillator so it was necessary to reject the FM signal before it got into the converter. I found a simple yet effective solution was to use a shorted stub across the transmission line just ahead of the converter. If the length of this

stub is properly adjusted to be a half wavelength at the FM frequency, it will place a short circuit on the transmission line thus attenuating the FM signal and at the same time the converter operation is unaffected since at six meters the stub is very nearly a quarter wavelength long and as far as a six meter signal is concerned the stub isn't there! The length of the stub will depend on the frequency of the FM station and the type of transmission line used for the stub. Fig. 1 gives the required length for the most popular types of coaxial cable as a function of FM frequencies. This was plotted from $L = 5905v \div f$ (mc.), where L is in inches and v is the relative velocity of propagation. For coaxial cables such as RG-5B/U, RG-8A/U, RG-9B/U, RG-11A/U, RG-58C/U, and RG-59A/U v is 0.67 and this was used to plot Fig. I. If a cable with a different v is used the length must be obtained from the equation. It is interesting to note that it is not necessary to match the impedance of the cable used for the stub to the impedance of the transmission line. The stub can be attached to the transmission line by inserting a coaxial tee at a convenient joint. It is a good idea to cut the cable a little long and prune for best results. Once the length has been determined solder the outer braid to the center conductor being sure the end is completely sealed and the connection is tight. There will be high circulating currents in the stub and a cold solder joint will reduce its effectiveness.

So there you are. For a scrap of cable and two spare coax fittings the blight of FM interference is removed from six meter operation. The technique outlined above can be extended to many other problems involving rejection of particular signals while not affecting others.

. . . W8HOA

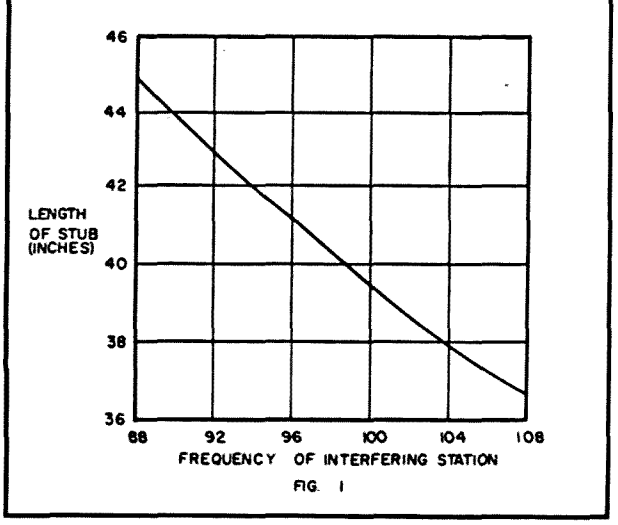


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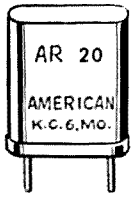
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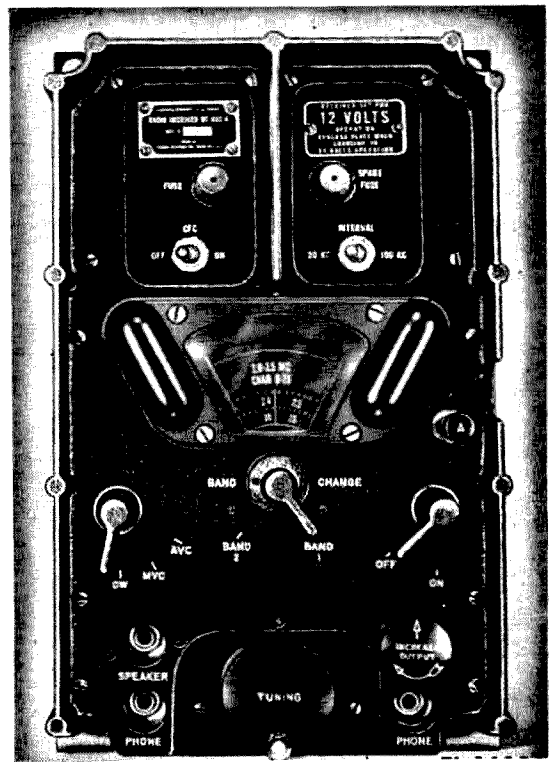
Converting

The BC-652 is an eleven-tube receiver covering the 2 to 6 mc range which has recently become available in quantity to Army MARS members. Although its frequency range is limited, it will cover the MARS 2, 3, 4, and 5 mc frequencies plus the 75 meter and 80 meter amateur bands.

Originally, it was a component section of the SCR-506-A which was designed for vehicular installation. It consisted of the receiver, a BC-653-A transmitter and a choice of either a 12-volt or 24-volt dynamotor.

A crystal frequency calibrator is incorporated in the BC-652 receiver, it includes a noise limiter, and it is capable of receiving AM, CW, SSB and RTTY signals.

Because of the internal interconnections involved in the complete SCR-506-A Radio Set, a small amount of modification is necessary to put the receiver section into operating condition when it is removed as a separate unit. These modifications are very simple as they involve only the addition of a power connector and three jumper wires to complete the filament circuitry.



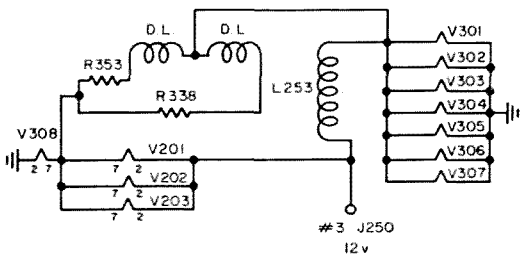
the BC–652

A schematic diagram which is on the bottom of each receiver, plus the revised filament wiring shown below, will be of assistance to those converting this receiver.

Use a Cinch-Jones 300 series connector which will mate with J250 on the receiver and perform the following steps to the *new connector:*

1. Connect nos. 1, 2 and 4 together, this becomes the common ground.
2. Connect no. 3 to 12 volts A.C.
3. Connect no. 6 to 175-200 volts D.C.
4. Connect filament and "B" supply returns to no. 1, 2 or 4.
5. Plug in the new connector.

The modified filament circuitry will appear as follows:



On P302, on the rear of the receiver, connect a jumper wire between nos. 5 and 8 to complete the V305 cathode circuit.

The 6Y6 audio output tube should be replaced with a 6K6GT tube to reduce the power drain on the 12-volt filament transformer.

Swamping resistors originally wired across the three *if* transformers could be removed, but may not make too much improvement in the performance of the receiver.

A three-tube crystal calibrator using a 200 kc crystal is built into the receiver and is controlled from the front panel. The 200 kc crystals do not come with the receiver and are available from Texas Crystals in Fort Meyers, Florida.

As the calibrator functions very well, it was left in the receiver, however, this entire section could be removed and a built-in power supply substituted.

The BC-652 is now available on the surplus market, and is excellent as a stand-by receiver or for use by the newcomers in the ham radio field.

. . . W1MEG

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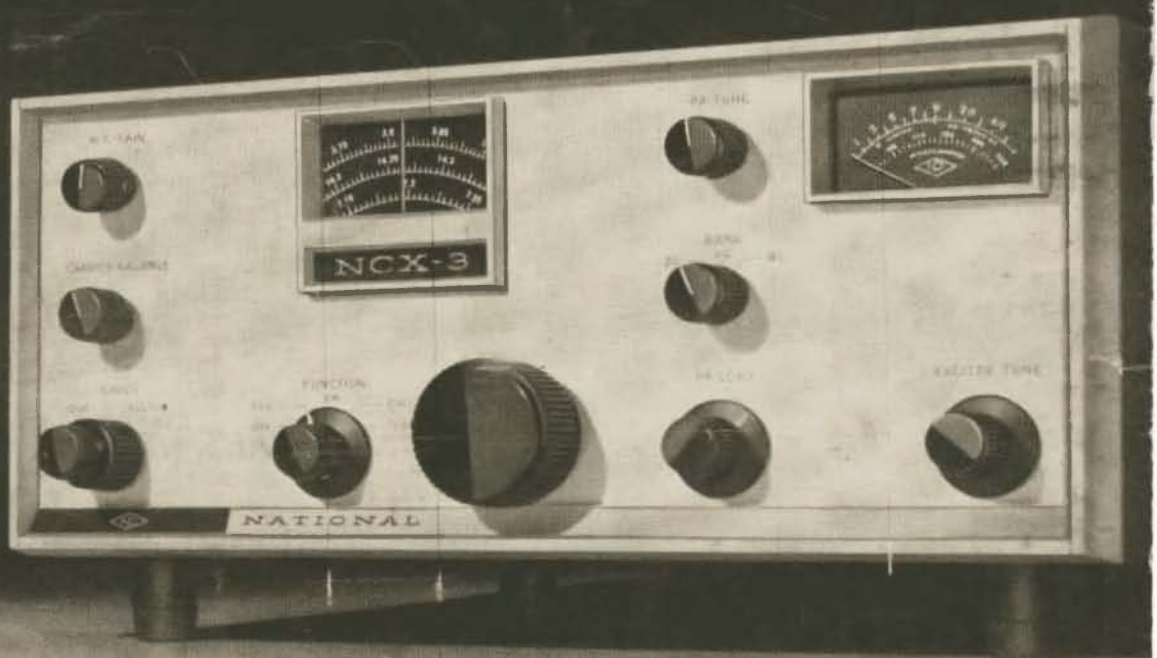
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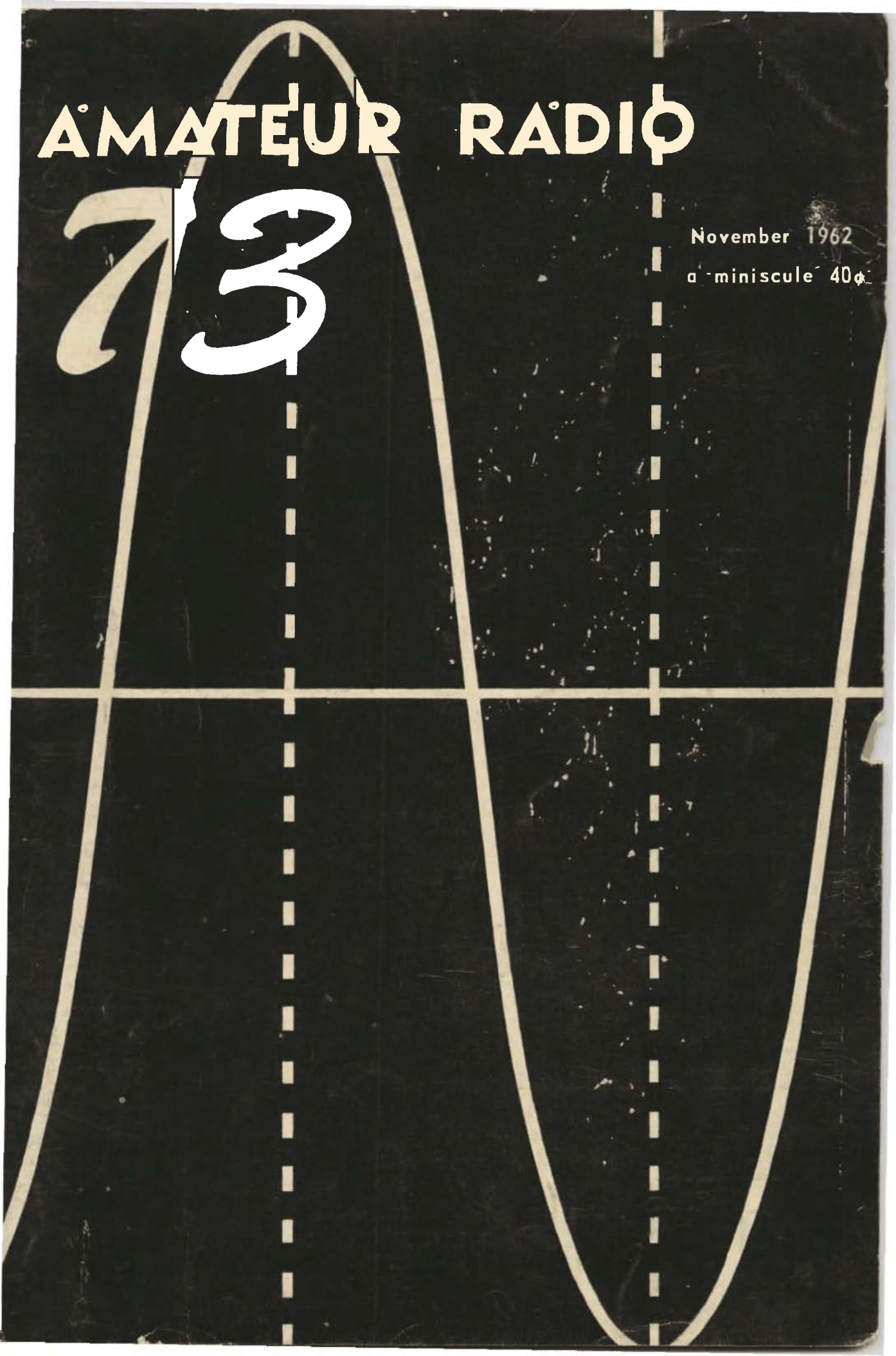
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AMATEUR RADIO

73

November 1962

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Magazine

Wayne Green, W2NSD

Editor, etcetera

November, 1962

Vol. XII, No. 1

Cover: Wayne Pierce KN3SUK

Solid State 1296 mc Converter W3HIX 6
Transistors on 1296? Good grief, what next? Sensitive too!

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73 tests the Gonset 220 mc Communicator W4API 24
Commercial equipment comes to the 220 mc band!

In Defense of the Operator WØOBF/2 26
A weak defense is better than no defense at all.

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Ha, ha.

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Complicating the Simplescope ..... WØOPA 52
Modifications and improvements of the Sept. 1961 article.

73 tests the Heath IM-30 ..... W5SJN 58
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Squelching that communications receiver used with a VHF converter.

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Can this be fiction?

Spotting Simplified W4MLE 66
Getting those "spot" switches to really do the whole job.

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Coax doesn't fare so well, we'll warn you.

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Big technical article. Rouser.

A Good Five Cent QSO W4MLE 90
George fights a losing battle with the lids.

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de W2NSD/1

On the Air Again

BETWEEN THE seven-day-a-week night and day job of getting 73 going and the restrictions of one of the nastiest landlords I've ever encountered, my hamming has been badly pruned back for several years. Even under the best of conditions it is difficult to make much of a mark while operating from Brooklyn. Antenna space is nil, the cement sops up all the rf, and you have more TVI per square inch than is believable.

This had a lot to do with our leaving the city. One of the important factors in our choice of a new home for 73 was the heighth and the clearness of the shot to the southwest for VHF operation.

Once moved into the new headquarters we set about getting a ham shack in operation. I'm not counting the Clegg 99'er and the halo hung out the attic window for local six meter contacts . . . this was installed and working before we had finished unloading the first truckload. The first installation was the Central 200V driving a Central 600L into a Hy-Gain tribander up on a forty foot Rohn tower. The receiver was a National 303. The results were marvelous! Every DX station I called came back and gave me encouraging reports. I hadn't been able to work out like that since my old ham station up in Troy, New York, at college where I racked up a rather good DX score and won several of the SS and DX contests.

Outside of some difficulty in getting the tribander to the top of the 40 footer, it was a snap getting a good signal onto the 10-15-20 meter bands. Dipoles hung from a couple of our 80' and 90' trees brought in nice reports on 40 and 80 meters. This left us with a lack on the VHF bands. This would never do. . . . I've been a staunch VHF'er ever since I started in ham radio (my first contact was on 2½ meters).

There is a big difference between getting on two meters with a Gonset and a halo and really putting a DX signal on the air. If you are going to do a serious job on two you have to have a minimum of a 16 element beam, two or three hundred watts, and a low noise converter. That beam has to be up in the air a ways, too. I looked over my gear and decided to throw caution to the winds and put up the best we could manage.

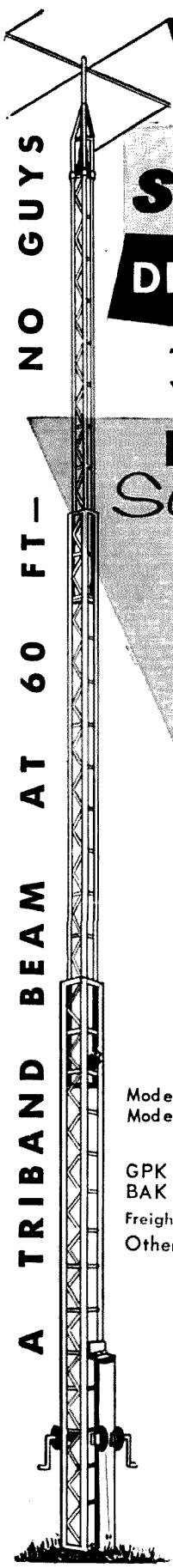
The first step was to order sixty feet more of Rohn tower and get the antenna above the 90' trees. The tower came in a few days, complete with erecting tool and guys. Art, VE1EY, arrived at this time with XYL and three harmonics in tow. Art announced that he was a rigger and could swing the tower into place in a couple hours. "Nothing to it." They moved in with us and five days later the tower was in place. I don't think Virginia likes kids any more.

Then, the day before our Open House, Bob Cushman of Cushcraft came over in his TR3 and unloaded a formidable pile of aluminum. He spent the whole day converting this "pick-up-sticks" into a 64 element beam. What a monster! It filled the whole backyard. This left only the small matter of putting the beam up on the tower. Ho, ho.

We needed an expert.

We got one. Pat Harris, W1HIV, son of Sam and Helen Harris, W1FZJ and W1HOY (also W1BU), who tends their forest of one hundred-plus footers, drove up with his safety belt and spent two days on the top of the tower getting the 64 elements in place. I hate to think how long it would take someone who didn't know what he was doing to put up a tower and beam like that.

The results were not quite as great as I expected. I hooked my Tapetone 417A converter through the NC-303 and used the Gonset Communicator with the Gonset linear, running about 50 watts output and worked over a range of about 100 miles. Over the next few days the band opened a little now and then and I managed many contacts with New York and New Jersey and even two with Philadelphia. As the



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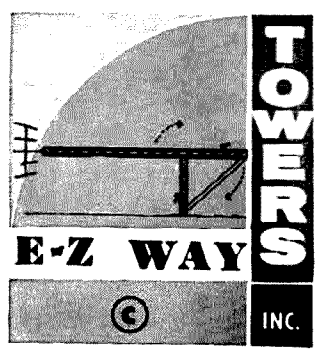
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September ARRL VHF Contest neared I dropped everything and worked furiously to get some higher power on the band.

A trip down to Meshna's in Lynn, one of the larger surplus houses in the Boston area, armed me with a couple of nice power supplies for bias and screens of my 4-125A's. The final amplifier is one I bought years ago for $30 from Herbach & Rademan. . . . I should have bought more. I wired in the high voltage supplies and modulator, complete with remote control between the transmitter in the basement and the radio shack right above. Some one hundred insurmountable problems later I not only had the rig on the air, but had it arranged for both phone and CW.

The 64 element beam didn't seem to be working very well, but it was hard to really tell without something to use for comparison. I sort of expected to put a slamming signal down into Boston, some 60 miles away, in spite of a rather high mountain directly between us. I didn't. Lenny, W1MEL, defying his chronic acrophobia ("I get sick"), quiveringly climbed the tower and hung a pair of the Cushcraft Big Wheels below the 64 element beam. When we found that they worked almost as well as the big beam, we knew that all was not well.

Jud, K2CBA, came over for a visit and looked over the beam. He climbed up the tower and pronounced all the phasing wires connected correctly. He felt, as I suspected, that our use of a light TV line for the feeder might be holding us back a bit. He came back the next weekend with some of the heaviest twinlead he could scrounge and, with the help of Mike, K2LZF, replaced the old line we had originally used. Gadzooks! What a difference. Signals came up about four "S" units on both transmitting and receiving. All of a sudden Connecticut and Long Island were coming in the way Massachusetts had been before. Now, if I can only locate some of that K200 line. . . .

Did someone say something about high power being expensive? Maybe so, but not the way I do it. The rig starts out with an old 522 transmitter, giving about seven watts output. The power supply out of an old TV runs this gadget just fine. From there I swing the rf through an old Gonset Two Meter Linear, bringing it up to about sixty watts . . . which is really enough for most applications. This drives the 4-125A's in the final. The final was surplus and cost $30, as mentioned previously. The bias supply is a $17 regulated job from Meshna, the RA-42. The screen supply, also regulated, came from Meshna for $20. The use

(Turn to page 92)

John Specialny Jr. W3HIX
Philco Corp. Lansdale, Penna.

1296 mc Converter

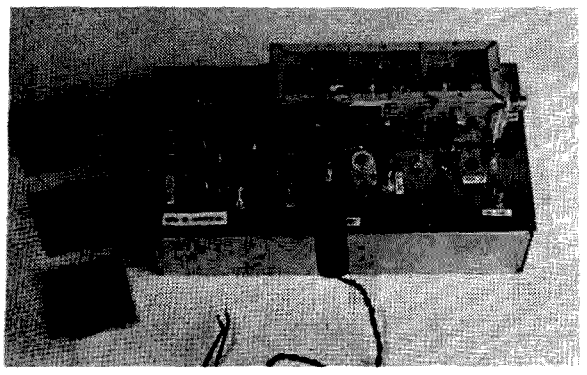
A CONVERTER IS described that operates at a signal frequency of 1296 mc utilizing semiconductors throughout. The converter is intended for ham communications on the 1296 mc band and could easily be adopted for moon bounce operation. An *if* frequency of 30 mc permits the use of any communications receiver capable of tuning this range.

Six transistors are used in functions previously performed by tubes. The use of transistors reduces the amount of heat generated both by the *if* stages and harmonic generators, thereby increasing frequency stability. A diode is used as a frequency tripler in the last stage of the frequency multiplier section. A low noise mixer diode is used in conjunction with a low noise *if* preamplifier (2.7 db) to provide extremely low noise operation. This converter has a measured overall noise figure of 8.5 db with a power gain of better than 50 db. The image response was at least 10 db down from the signal frequency.

Circuit Description

Fig. 1 shows the schematic diagram of the entire converter.

Philco's 2N1742 MADT transistors are utilized in the oscillator and the three frequency doubler circuits. All are operating in the common-base configuration. A 1N147 type mixer diode is used as the diode frequency tripler. The 2N1744 MADT type which is specified for oscillator service was considered for the multiplier stages but was found to have lower power gains than the 2N1742 which due to its higher gains provided more drive to the diode tripler stage.



Top View of 1296 mc Converter.

The 1266 mc heterodyning signal for the 1N263 diode mixer is generated by a 52.75 mc crystal controlled oscillator, three Class "C" frequency doublers and a diode frequency tripler.

In the oscillator output circuit, capacitor C_1 and coil L_1 are tuned to 52.75 mc. The 1.5 to 7.0 mmfd trimmer in the emitter circuit is adjusted for maximum output consistent with stable oscillator operation. With certain crystals it may be necessary to add about 1.0 mmfd of capacitance between the collector and emitter terminals. Winding L_2 couples the output from the oscillator to the input of the first doubler. Capacitor C_3 and coil L_3 tune the output of this stage to 105.5 mc. A tap on coil L_3 couples the 105.5 mc output to the emitter of the second doubler. Capacitor C_4 and coil L_4 tune the output of this stage to 211 mc.

A low impedance tap on coil L_4 couples the 211 mc output to the input of the third doubler. A strip line tank circuit consisting of capacitor C_5 and coil L_5 tune the output to 422 mc. A copper type shield serves as the enclosure for this tank circuit.

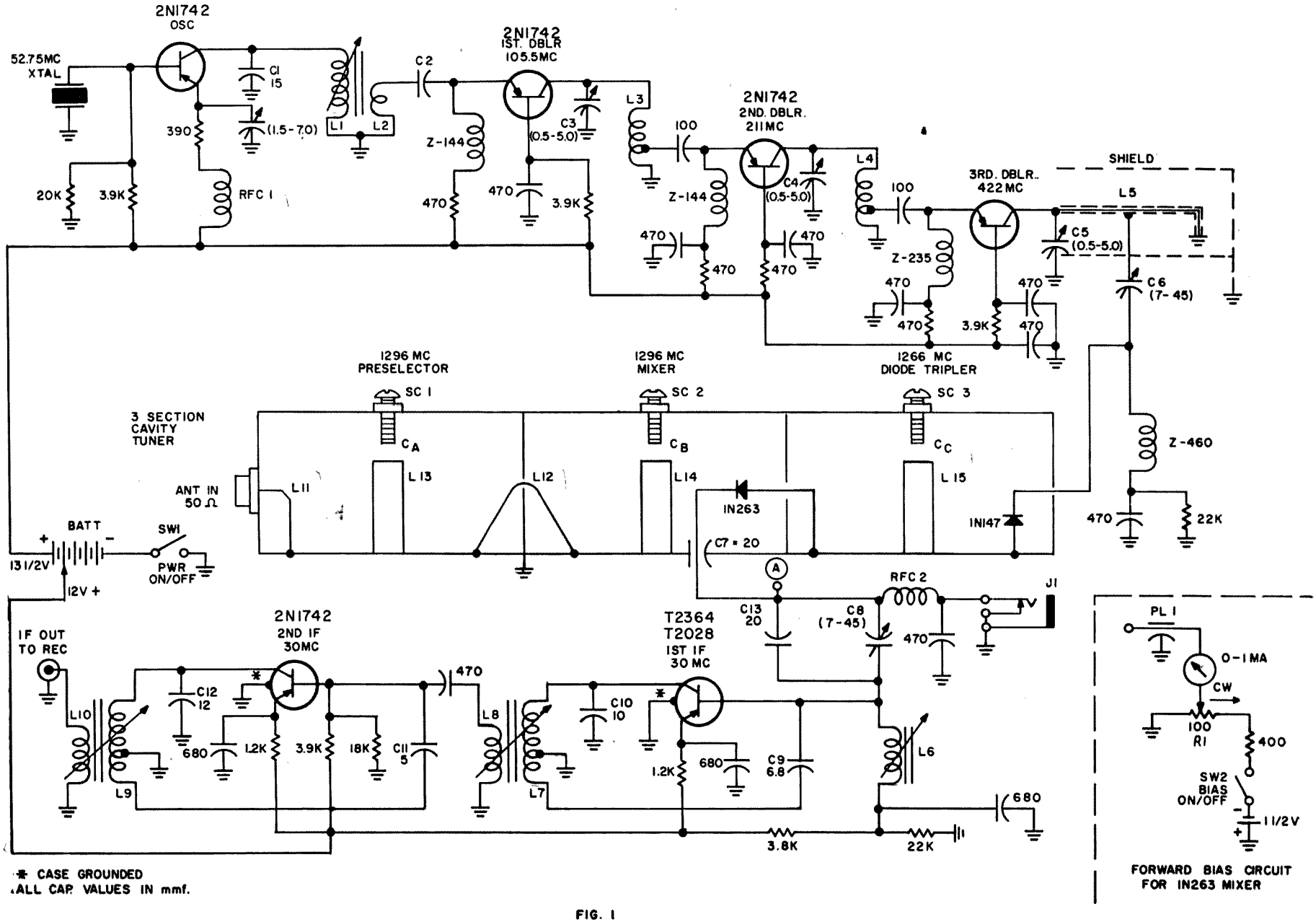
Driving of the 1N147 multiplier tripler diode to 1266 mc is through the variable matching capacitor C_6 tapped onto L_5. Inductor L_{15} with the capacitance C_c formed by the tuning screw SC_3 is tuned to 1266 mc.

Inductors L_{13} and L_{15} and capacitors C_A and C_B formed by the tuning screws SC_1 and SC_2 respectively, are preselectors tuned to 1296 mc. Loops L_{11} and L_{12} couple the signal from the antenna through the preselectors to the 1N263 diode mixer.

The 30 mc output of the mixer is amplified in two common-emitter *if* stages. Coupling to the T2364 first *if* amplifier is through a network consisting of coil L_6 and capacitors C_7, C_8 and C_{13}. C_8 and L_6 are adjusted for the lowest noise figure. The *if* system noise figure was measured to be 2.7 db. A T2028 can be used in this stage with a slight deterioration in the noise figure. Capacitor C_{10} and coil L_7 are tuned to 30 mc. Inductive neutralization is provided by the tapped output coil L_7 and capacitor C_9.

Secondary winding L_8 provides the coupling to the 2N1742 second *if* amplifier. Capacitor C_{12} and coil L_9 are tuned to 30 mc. Inductive neutralization is obtained by the tapped output coil L_9 and capacitor C_{11}. The converter output is coupled to the input of the receiver through secondary winding L_{10}.

Application of forward bias to the 1N263



* CASE GROUNDED
ALL CAP. VALUES IN mmf.

FIG. 1

TM

diode mixer gives about a 3 db improvement in noise figure. Jack, JK_1 and plug, PL_1 provide the means of introducing the forward bias in the mixer circuit. R_1 and the 1266 mc diode tripler tank circuit are adjusted for best noise figure. The 1N263 mixer current is in the range of 300 to 400 μa with forward bias and about 200 μa with the bias removed. The mixer can be operated without forward bias if the loss in noise figure can be tolerated. After aligning the converter for maximum gain the input preselectors may need to be trimmed for the minimum noise figure.

Chart I indicates the approximate current drawn by the individual stages. The current that flows in the multiplier stages is dependent upon driving power and tuning.

Osc.	1st Dblr.	2nd Dblr.	3rd Dblr.
5.0 ma	3.0 ma	5.0 ma	2.0 ma

1st IF	2nd IF	Bleeder Current	Total Current
0.6 ma	1.7 ma	1.2 ma	18.5 ma

Alignment Procedure

The *if* system should be first tuned to 30 mc. This is done by connecting the output of the *if* section to the antenna terminals of the 30 mc receiver and applying bias. Modulated output from the signal generator is inserted at point A. The mixer diode is removed from the circuit during this part of alignment. Adjust the coils of L_6, L_7 and L_9 for maximum output on the receiver.

The multiplier section can best be adjusted by use of a grid dip oscillator. With the GDO operating as a wave meter, it should be coupled to the oscillator tank coil and core of

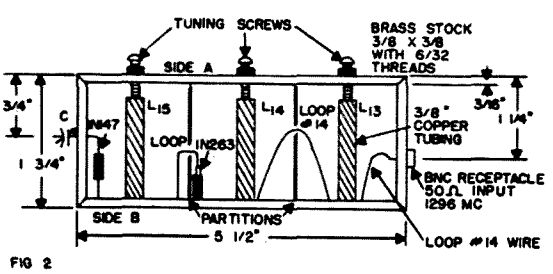


FIG 2

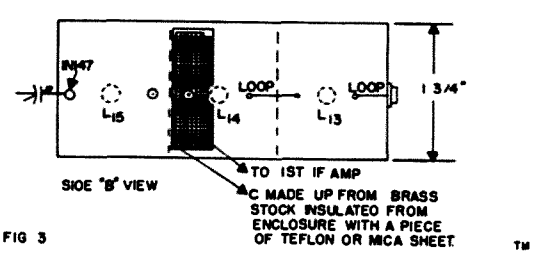
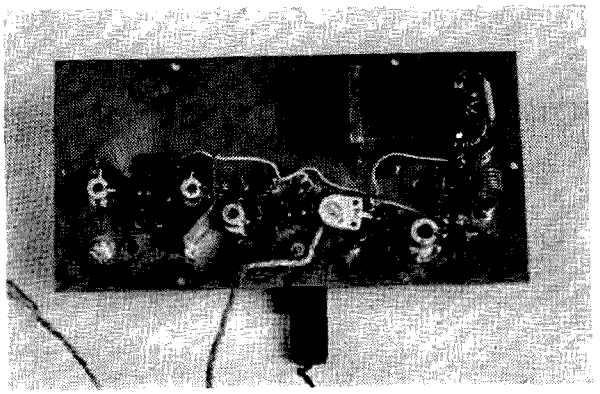


FIG 3



Bottom View—Note the copper enclosure for L5 in upper right hand corner.

L_1 adjusted for maximum output. The variable trimmer (1.5-7.0 mmfd) in the emitter circuit should also be set for maximum output. With the wave meter set to 105.5 mc and coupled to L_3, adjust capacitor C_3 for maximum indication.

The wave meter is next set to 211 mc coupled to L_4 and C_4 adjusted for maximum indication on the wave meter. Finally, with the wave meter coupled to L_5 at a frequency of 422 mc, adjust C_5 for maximum indication on the wave meter.

By connecting a 0-5 ma meter across the 22K resistor in the dc return for the 1N147 diode tripler, all of the multiplier stages and capacitor C_6 can be trimmed by tuning for a maximum indication on the meter. Remove the meter after this alignment.

The 22K resistor in the 1N147 bias circuit develops back bias or self bias for the diode. The multiplying action is more efficient when the diode is biased in this manner.

With the antenna connected to the input terminal on the cavity tuner, adjust tuning screw SC_3 and C_6 for maximum mixer current as measured at Jack JK_1. With a 1296 mc signal applied to the input connector, adjust tuning screws SC_1 and SC_2 for maximum output. If a noise generator is available, apply to antenna input and adjust all of the tuning screws and potentiometer R_1 for minimum noise figure. Only slight adjustment of the tuning screws is necessary to optimize the noise figure.

Chart II indicates the approximate power output delivered by the oscillator and the succeeding multiplier stages.

Osc.	1st Dblr.	2nd Dblr.	3rd Dblr.
10 mw	14 mw	9 mw	6 mw

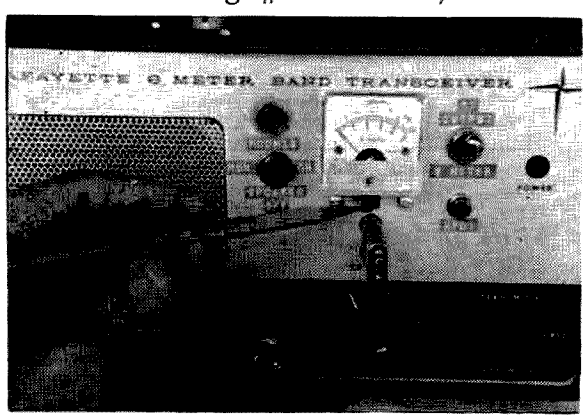
(Turn to page 79)

Deluxe your Transceiver

Fred Blechman K6UGT
23958 Archwood Street
Canoga Park, California

IF you would like to add some "deluxe" features to your inexpensive transceiver, this article will show you how to add: an illuminated meter for tuning both the receiver and transmitter; a tuning control for the transmitter; a "spotting" switch; an earphone jack that can also be used for tape recording and modulation monitoring. "Bandspreading" the tuning range of the receiver will also be covered.

The Lafayette HE-35A Six Meter Transceiver has been chosen as the example for several reasons. It is a "natural" for modifications, since half the front panel is not occupied. It is a "typical" unit, having a superheterdyne receiver, variable noise limiter and 7-watt transmitter neatly packaged in a steel case 10⅝ x 5 x 6¾, with a built-in speaker and 117 vac power supply. Made in the U.S.A., the HE-35A comes completely wired, with a ceramic hand microphone and a third-overtone 50.2 megacycle crystal, for $57.50 (Lafayette Radio, 111 Jericho Turnpike, Syosset, L.I., New York Catalog #HE-35AWX).



G-16—The front panel of the "Deluxe" HE-35A. The small switch under the meter turns on two small bulbs included in the meter case. Note the added "pointer" on the receiver tuning dial.

Two other nationally available transceivers are virtually identical to the HE-35A: The Lincoln 6 Meter Transceiver (Allied Radio, 100 N. Western Ave., Chicago, Illinois. Catalog #78SZ195, $57.50) and the DeWald 6 Meter Transceiver, Model TR-850 (Burstein-Applebee Company, 1012 McGee St., Kansas City 6, Missouri Catalog #35A468, $69.95). Ready-wired power supplies are available for 6 or 12 volt mobile use that plug into the cigarette lighter for connection to the battery, and plug onto the back of the transceiver.

The modifications described are relatively simple, and enough explanation is given to allow their application to similar Amateur and Citizens-Band equipment.

Adding A Meter

Perhaps the most desirable change to any piece of communications equipment, not already having a tuning device, is the addition of a meter. Normally, this is a relatively expensive device, and consumes a lot of panel space. However, with the availability of the Lafayette TM-11 Illuminated "S" Meter, the expense and space problem has been overcome. Only 1⅝ inch square, with a sensitivity of 1 milliampere full-scale, jeweled bearings, plastic front, 3-color dial face with 3 sets of scales, and two built-in grain-of-wheat bulbs for 6 or 12 volt illumination, this meter sells for only $2.95! It is added to the HE-35A front panel as shown in Photo G-16. A single-pole-single-throw (SPST) slide switch (S2) is placed directly below the meter to control the built-in bulbs. A double-pole-double-throw (DPDT) toggle switch (S1) is used to select meter function, and it is placed alongside the meter.

The meter serves three useful purposes when wired as shown in Fig. 1. With the meter selector switch (SI) in the "S-Meter" position, the relative strength of incoming signals is shown, and the receiver can be tuned to the "center" of the received carrier; also, when used with the "spot" switch described further on, it gives definite indication of transmitting crystal activity and frequency on the receiver dial. In the "RF Output" position of

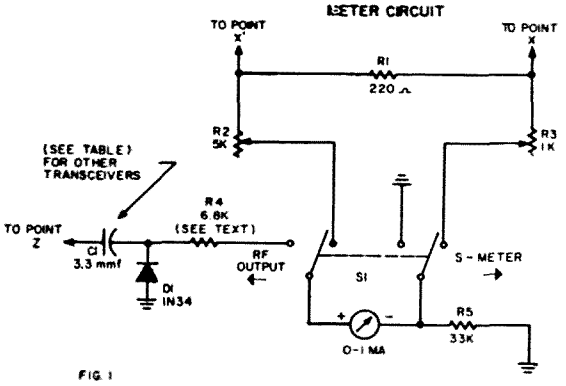


FIG. 1

S1, the transmitter final tuning capacitor may be adjusted for maximum output on the meter.

To add the meter circuit break the connection at "X." This can be located by following the normally-connected lead of the transmit receive switch. This lead goes to a terminal strip under the chassis. Locate the 10K resistor (brown, black, orange) that goes to pin 3 of V2 (via the *if* can), and disconnect this resistor from the terminal strip. Connect this free end of the resistor to an unused lug of the terminal strip. Now wire in the circuit in Fig. 1.

An explanation of the circuit allows its use in almost any transceiver. When SI is in the "S-Meter" position, fixed resistors RI and R5, and variable resistor R3, form three legs of

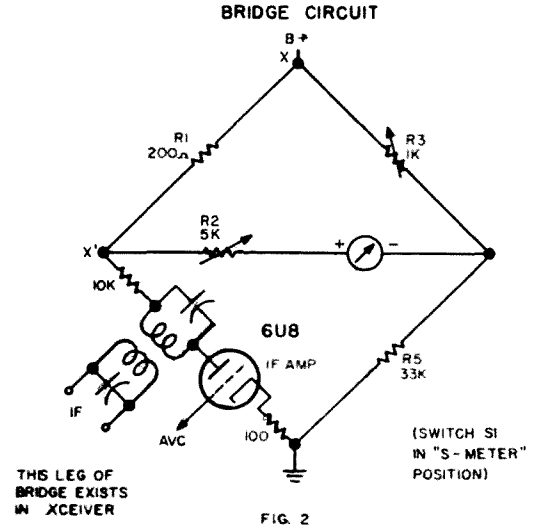
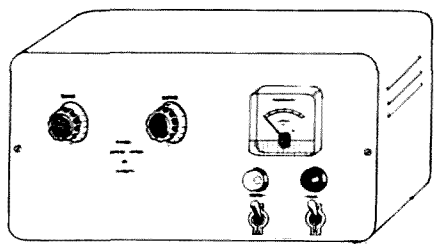


FIG. 2



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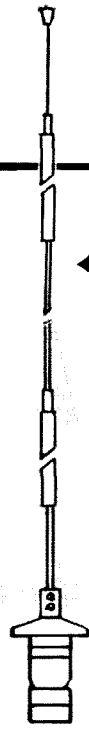
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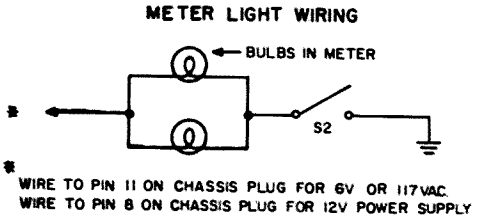


FIG. 3

a Wheatstone Bridge circuit, with the transceiver *if* amplifier circuitry as the fourth leg. See simplified schematic, Fig. 2. The meter is used as a voltmeter across the bridge output, with R2 used to limit meter current. The bridge is powered at point X, and is balanced in a no-signal condition by adjusting R3 for a zero meter reading (about 400 ohms). When a signal is received, the receiver AVC action changes the impedance of the *if* amplifier leg of the bridge, thus throwing the bridge out of balance, and creating a voltage across the series combination of R2 and the meter. R2 is adjusted for a full scale reading (about 1300 ohms) on the strongest local signal. Do not be alarmed if the meter "pins" when the transceiver is turned on; the bridge is severely unbalanced for a few seconds until the *if* tube warms up.

The meter lights should be connected as shown in Fig. 3. If to be used on 6 volts or 117 VAC, connect to chassis plug pin 11. For 12 volts use only, connect to pin 8. Switch S2 is in the circuit to allow the meter illumination to be shut off when not needed, since the bulbs have a limited life (about 50 hours on 12 volts).

When S1 is in the "RF Output" position, radio frequency energy from the antenna connection is coupled thru C1 and rectified by D1, with the resultant dc voltage fed to the meter through R4. The reactance of C1 should be approximately 1000 ohms at the operating frequency, so the rf power drawn by the meter is negligible compared to the much lower antenna impedance of around 50 ohms. Suggested values of C1 for various frequencies are shown in Table 1. The value of R4 should be selected to provide near-full-scale reading when the transmitter is tuned to maximum output into the antenna to be used. The meter reading is only to indicate relative output on a given antenna, and will give different maximum readings with different antennae; it is essentially an rf voltmeter, and therefore reads the standing wave voltage on the antenna line at the point to which it is connected.

When changing crystals in the HE-35A, it is usually only necessary to adjust the variable slug-tuned capacitor (C-1) for maximum output on the meter. Slug L-4 and capacitor C-4 can be adjusted to cover a broad range of crystal frequencies, and very little is gained by retuning them each time the crystal is changed. As shown in Fig. 4, a tuning wand to adjust C-1 may be made from ¼ inch diameter polystyrene tubing. A thin metal sliver, or a piece of fine music wire, is heated and inserted through the side of the tubing to form a "key" for the slot in the tuning slug. A small sheet-metal adapter plate with a ¼-inch hole is positioned above C-1 with sheet metal screws. This covers the oversize hole in the top of the HE-35A case, formerly used to allow access to tuning both C-1 and C-4. The polystyrene tuning wand is slipped thru the adapter hole, over the tuning slug, and turned until the "key" drops into the slug slot. A round set-screw knob is added to the top of the tuning wand, and a sheet metal retainer prevents the wand from falling out. See Figure 5. CAUTION: Be sure to remove the wand before attempting to remove the HE-35A from its case.

Spotting Switch

The addition of a "spotting switch" to a transceiver allows the operator to locate his own transmitting frequency on the receiver dial. This is useful for receiver calibration purposes and to judge the frequency of an incoming signal. If your transmitter has a variable-frequency oscillator (VFO), a spotting switch allows you to "zero-beat" (match the frequency) of an incoming signal. The addition of a spotting switch is usually a simple wiring job, and the HE-35A is a good example as shown in Figure 6. Break the connection between pins 1 and 6 of the oscillator-amplifier tube (6CX8 V4) and add a SPDT pushbutton

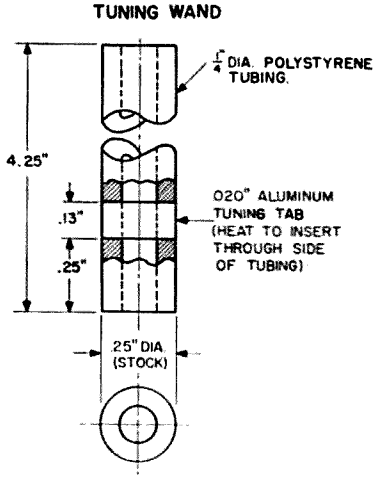
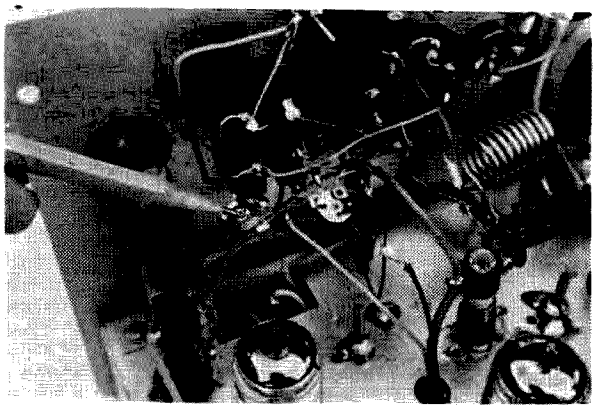


FIG. 4.



H-16—Behind-panel view of the "Deluxe" HE-35A. Point-to-point wiring was used, since the author's unit is not being used mobile. However, tie points or terminal strips should be used for the new wiring junctions if the unit is going to be subjected to rough handling. Note the ultra-miniature variable resistors used to "align" the S-meter circuit.

switch (S3), mounted below S1 on the front panel. When S3 is in its normal position, pins 1 and 6 of V4 are connected to the transmit-receive switch as before. However, when the spotting switch is depressed, only the oscillator cathode of the tube is grounded, while the receiver is operating. This allows the oscillator to generate a relatively low-level rf signal on the crystal frequency which does not "block" the receiver. Using the newly installed S-meter, tune the receiver for maximum, and that's the "spot" on the dial at which you'll be transmitting in normal operation. Various crystals can be used to calibrate the receiver dial in this manner.

Speaker Selector Switch and Jack

It is often desirable to use earphones in place of the speaker to prevent disturbing others. A jack on the front panel can accommodate this need. This jack can also be used on those occasions when tape recording from the air is desired, such as when receiving a message or running modulation tests. However, if the jack disables the speaker, you can't hear what's being recorded! Also, sometimes you want to check your own modulation to verify proper operation of the microphone and speech amplifier circuitry. Your choice of the above can be accomplished by adding speaker selector switch (S4) and earphone jack (J1) as shown in Fig. 7.

Note that J1 must be *insulated from the panel* of the HE-35A with the insulating washers called out in the parts list! Connect J1 across loudspeaker voice coil. When the transceiver switch is in the receive position the jack receives the signal from the output transformer.

TUNING WAND INSTALLATION

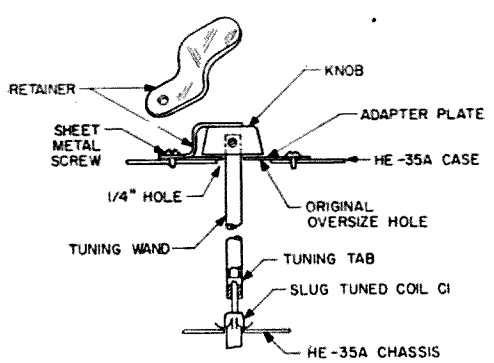


FIG. 5

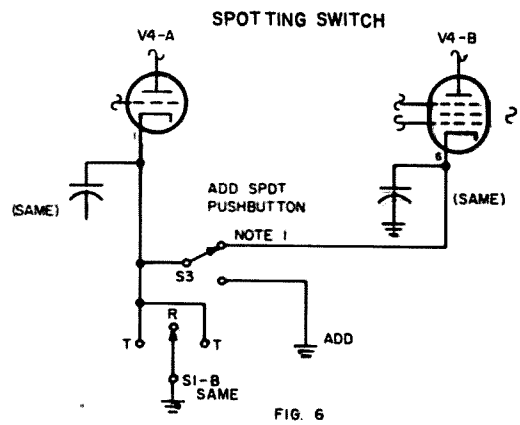


FIG. 6

NOTES:

1. Remove jumper from pin 1 and add Lafayette MS-449 pushbutton switch as shown.
2. Tune for max. on S meter for SPDT.

In operation, S4 is left in the "on" position. When earphones or a tape recorder input plug are inserted in J1, S4 may be left "on" to monitor, or placed in the center "off" position to disable the speaker. When transmitting, if S4 is put in the "monitor" position, the speaker will monitor your modulation. R6 is used to prevent overloading the speaker and reduce acoustic feedback. If howling and

TABLE I

FREQ. (mc)	CI (mmfd)
3.5	47
7	22
14	10
21	6.3
27	5.0
30	5.0
50	3.3
144	1.0



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whistling are evident in this mode of operation, increase the value of R6.

Bandspread

Most 6 meter and Citizens-Band receivers cover the entire band, but it may be desired to tune only part of the band. This allows less critical tuning, making it somewhat easier to separate adjacent stations, and to tune quickly without missing a station. On 6 meters only the first two megacycles of the 50-54 megacycle band are active, so the HE-35A was modified to tune only to 50-52 megacycles. This was accomplished by merely changing the 15 mmfd capacitor in series with the tuning capacitor to a 6.8 mmfd NPO (zero drift) unit. Various other values may be tried to "spread" the tuning range the desired amount. The smaller the value of the substitute capacitor, the smaller the portion of the band covered. It will be necessary in each case to reset the receiver oscillator slug (L-3) to bring the desired portion of the band in the tuning range of the receiver.

If your tuning arrangement is not like the HE-35A, bandspread may not be a simple matter. The better superheterodyne receivers have dual-ganged tuning capacitors for improved selectivity and image rejection. The HE-35A has a broad-band RF amplifier, and only the oscillator is tuned by the front panel control for station selection. In most super-regenerative receivers, however, the tuning arrangement is similar to the HE-35A and the series capacitor, as shown here, will provide

SPEAKER SELECTOR

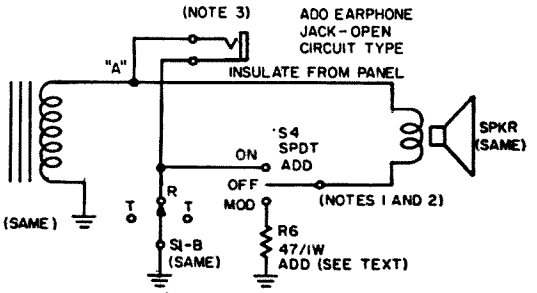
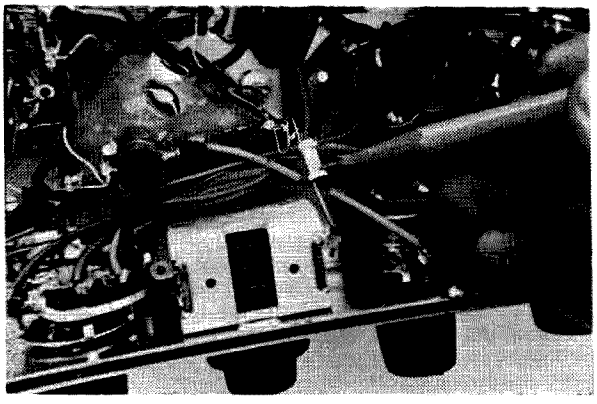


FIG. 7

NOTES:

1. **Switch should be SPDT center off.**
2. **Position 1: Speaker on**
   Position 2: Speaker off
   Position 3: Modulation monitor (when transmitting or testing mike)
3. **This jack may be used for input to tape recorder. Switch allows monitoring while recording.**
4. **Earphones: 6-2000 ohms.**



H-17—Under the HE-35A chassis. Changing the capacitor indicated (the new one is shown) will "bandspread" the receiver.

bandspread.

Reading the receiver dial of the HE-35A is somewhat of a guess, since the indicator dot on the tuning knob is far from the numbers on the panel, and parallax is extreme. This can be corrected by simply gluing a thin triangular-shaped piece of plastic or celluloid to the bottom of the main tuning knob after scratching a line in the plastic and filling it with white ink to act as a "pointer."

There are many other potential changes to a versatile rig like the HE-35A. Conversion of the oscillator to use cheaper 8 MC. crystals in place of the presently used third overtone crystals, could be done by adding another tube. However, this is not such a simple change, and the harmonics generated could lead to television interference problems. Front-panel tuning of the transmitter output would be nice, but hardly worth all the trouble. Addition of a beat frequency oscillator (BFO) to receive CW code would be useful to only a limited number of operators; transmitting CW would require the addition of a keying jack, and "chirp" would be a problem.

The HE-35A and similar units will look better and be more efficient and convenient to operate if the changes described are incorporated. The effort and cost are small; the result: a deluxe transceiver!

. . . K6UGT

PARTS LIST

R1—220 ohm ½ watt composition resistor.
R2—5000 ohm variable resistor (Lafayette VC-58 29¢)
R3—1000 ohm variable resistor (Lafayette VC-57 29¢)
R4—6.8 K ½ watt composition resistor (see text)
R5—33k ½ watt composition resistor
R6—47 ohm 1 watt composition resistor (see text)
S1—DPDT toggle switch (Lafayette SW-22 32¢)
S2—SPST slide switch (Lafayette SW-14 9¢)
S3—SPDT pushbutton switch (Lafayette MS-449 19¢)
S4—SPDT center off toggle switch (Lafayette SW-27 39¢)
C1—See Table I
C—bandspread—6.8 uufd. NPO (Allied Radio 19L960 29¢) (see text)
M1—0-1 ma. meter (Lafayette TM-11 $2.95)
J1—Open circuit phone jack (Lafayette MS-441 19¢)
Insulating washers for J1: Lafayette P-204 35¢/box of 20
¼ diameter polystyrene tubing (Lafayette P-470 10¢)

Junction Checks

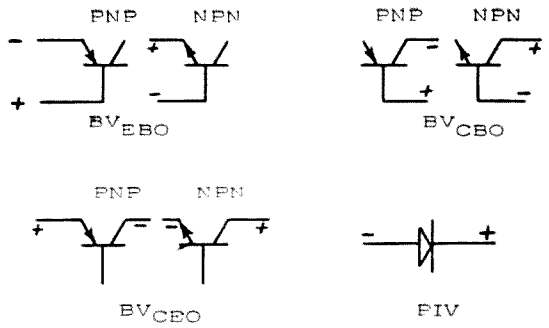
Quick and Dirty

Samuel Daskam K2OPI
Clark Semiconductor Corp.
Walnut Ave., Clark, N. J.

PERHAPS the most annoying part of using transistors for breadboarding experimental circuits is in trying to determine whether or not the junctions are still good after the initial use. There are many types of transistors and rectifiers on the surplus market, some of which have to be bought "as is." Without some kind of measuring instrument to check the collector-to-base and emitter-to-base junctions, it is very difficult to utilize these devices.

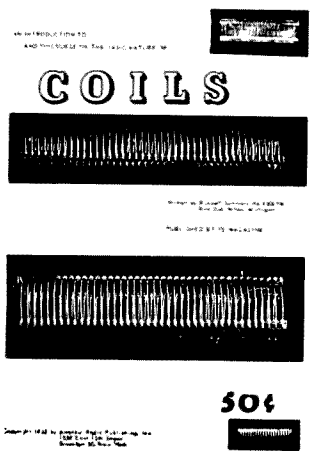
A method is described here which utilizes a resistance-capacitance comparator bridge. This instrument is widely used by many experimenters and a new application of existing equipment is always welcome. Although an Eico Model 950B Bridge was used to investigate this application, other makes should work equally well.

The "electrolytic test" position of the bridge is normally used for checking the leakage of electrolytic capacitors as a function of the voltage across the capacitor. As the voltage applied across the electrolytic is increased by turning the front panel control on the bridge, the relative leakage is indicated by the closing of the tuning eye.



Since a semiconductor rectifying junction acts in a manner similar to an electrolytic capacitor in a test such as this, it was only a matter of making a few experiments to determine if the RC Bridge could be used for checking transistors and rectifiers. Fig. 1 gives the hook-ups needed to measure the various breakdown voltages such as BVebo, BVcbo, BVceo, and the peak inverse voltage of rectifiers.

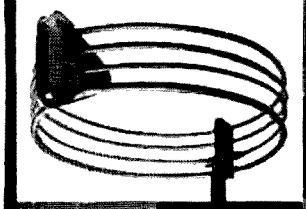
The procedure is simply to connect the transistor or rectifier leads to the correct terminals of the bridge so that the applied voltage reverse biases the junction. The easiest way to make the connection is to use alligator clip leads. A voltmeter should also be connected across the terminals since loading down the bridge will cause inaccuracies in the voltage dial calibration. Next increase the voltage control and watch the magic eye tuning indicator. When the eye starts to close, the voltage is approaching the breakdown voltage of the junction. No harm will come to most transistors and rectifiers if the breakdown voltage is exceeded during this test, since only 4 or 5 milliamps are required to close the eye. The voltmeter reading will usually only go as far as the breakdown voltage of the junction under test regardless of the voltage setting. This is because loading the power supply in the bridge causes the voltage to be dropped internally. . . . K2OPI



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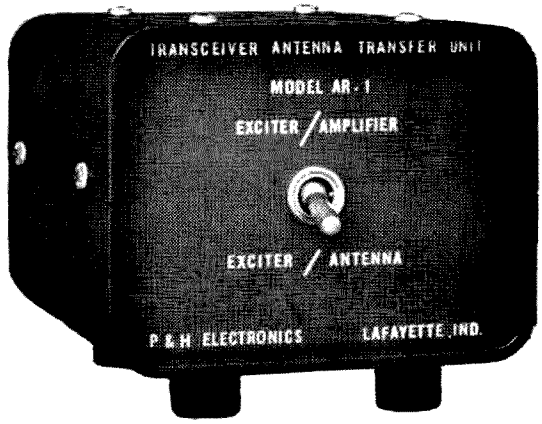
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The AR-1 requires 6.3VAC (6.3V jack on KWM-2) and normally open auxiliary contacts on the exciter relay. (ANT. RELAY jack on KWM-2). The AR-1 may also be used as a conventional antenna change-over relay. Size 3" X 4" X 4".

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The Continental Six

first six meter SSB station in New Hampshire

Paul Day W1PYM

Strange things are happening on six. In almost any part of the country nowadays, Donald Duck type noises can be heard on the low end of the 'phone band. The success of SSB on the lower bands has inspired not a few VHF men and several manufacturers to think about what it might do for six. With low band SSB exciters in common use, the logical approach seems to be a simple heterodyne converter. Several of these have appeared on the market and one of the neatest is the Continental "Six" designed by K4RLX.

Circuit Description

The Continental "Six" uses a 6U8 as a triode crystal oscillator/pentode buffer amplifier combination to provide a 36 mc local oscillator signal to the grid of a 5763 mixer. Output of a 14 mc exciter is injected through a tuned circuit in the screen of the mixer and the 50 mc sum frequency is selected by the 5763 plate circuit. A 2E26 operates as a straight through final amplifier on 50 mc. The final screen voltage is regulated by two OB2 miniature VR tubes. A 1N34 crystal diode coupled to the pi-section output tank provides relative output power indication on the front panel meter.

Controls and Adjustments

The front panel of the Continental "Six" consists of only two tuning adjustments, two switches, two indicator lamps and the meter. Nothing else is necessary and even these few controls may be left alone after initial adjustment. The 36 mc oscillator and amplifier tuning and the 5763 plate tank are slug tuned coils preset at the factory and normally need not be touched. These are located on the chassis and easily accessible with the case removed. The 2E26 plate tank is the familiar pi-section coupler. Its tuning and loading capacitors are the two controls on the front panel. One setting on these controls is normally all that is required for SSB operation, but they may need readjustment for frequency changes of 250 kc or more away from the original operating frequency. One of the switches on the front panel switches the 2E26 plate voltage off and on. The other selects either 2E26 plate current or relative power output to be read by the meter. A sensitivity adjustment for the power output position is provided inside the cabinet.

Trying it Out

So much for the internal workings. Now let's make it work and see what happens. Making it go is so easy it's hardly worth writing about. Simply plug in the power supply and the drive, connect your 6 meter antenna relay and away we go. A word of caution. The converter only needs 5 watts maximum of 20 meter drive. Most popular exciters provide much more than this and must be padded down. Continental has 3, 6, and 9 db pads available or roll your own, but don't put more than 5 watts in the input pipe. Full instructions for tuning up are provided in the instruction book. Once I had the sample unit tuned up, I never had to touch the controls again. In fact my exciter (a 32S1) required more retuning than the converter.

Results

After the initial tuning up and playing around to get the feel of operation, the first single sideband station on six in New Hampshire was put on the air. As luck would have it, I got going just too late to catch the Summer sporadic E season and had to be satisfied with local contacts. With a 3 element beam hardly off the ground good solid contacts were made

all over southern New Hampshire and eastern Massachusetts. The exciter was recognized immediately as an S-Line by most of the regular SSB gang. Contacts were made on CW and AM as well with excellent results. In fact, anything the 32S1 would do on 20, it did on six with enough sock from just the barefoot converter to be heard. All in all the Continental "Six" seems destined to be the flyweight champ on six and should do its part to popularize SSB as a practical VHF mode of operation.

Continental "Six" Specifications

Power rating: 30 watts p.e.p. SSB and CW, reduced ratings on AM
Drive requirements: 1-5 watts from 20 meter source
Drive available at output for next stage: 15 watts minimum
Dimensions: 5 3/16 inches high, 8⅝ inches wide, and 11⅜ inches deep
Power supply required: 400 VDC at 100 ma.
150 VDC regulated at 30 ma.
6.3 VAC at 2 amperes
Price: $99.95

Letter

Dear Wayne:

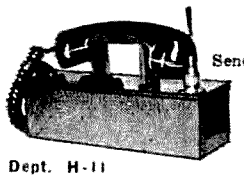
I wish to compliment you on that portion of your editorial in October 73 which deals with the League. It has always been my feeling that membership in the League is much more than a mere subscription to QST and I encourage all amateurs to subscribe to more than one amateur magazine, but to consider that their League affiliation is their democratic voice in the internal affairs of amateur radio. Your description and explanation of ARRL should do much to put into proper focus the purpose of the League and to encourage all active amateurs to support it.

Do you anticipate any further aims of the Institute of Amateur Radio than that of the proposed ham flight to Europe? If so, I would be most interested in hearing about them with a consideration of charter membership.

Carl L. Smith W$_{\phi}$BWJ
Director, Rocky Mtn. Division

The Institute will, if our mail is any indication, be involved with the fostering of technical improvements and dissemination of information on special amateur interests such as TV, RTTY, beacons, repeaters, scatter tests, moonbounce, etc.

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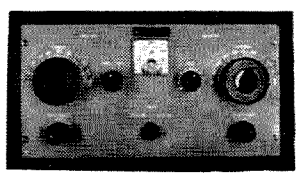
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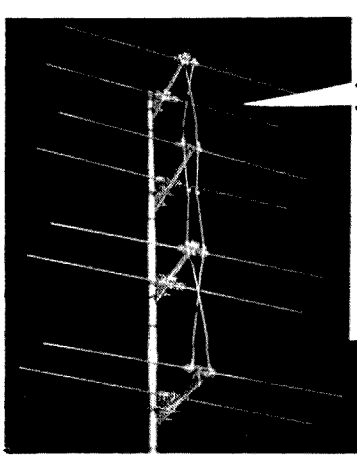


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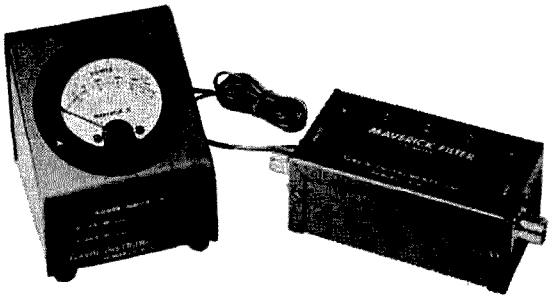
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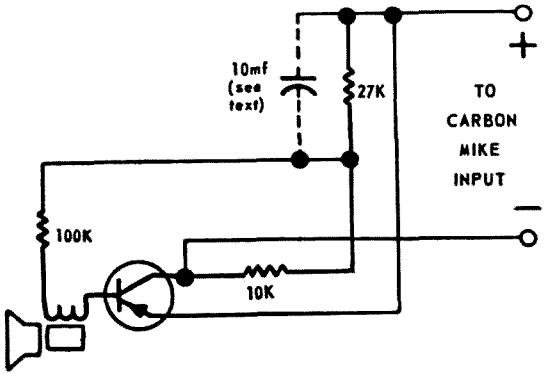
IN the early days of transistors, one of the favorite construction projects for ham use was a transistorized microphone for mobile use.

The superb semiconductor is more than 10 years old now, and most of the homebrew-mike projects have long since gone by the boards, but here's one far simpler than any which appeared in print in earlier years—which can still find a place in most any mobile station.

The circuit is an adaptation of a custom mobile mike built by Two-Way Radio Communication Co., of Oklahoma City, for its customers, which in turn was an adaptation of the Shure transistor dynamic mike and the Motorola model of the Shure.

Its main feature is complete elimination of any dc power supply for the transistor. This mike is a plug-in replacement for any carbon microphone; the transistor is powered from the same source originally used to power the carbon button.

If you want to be as fancy as the commercial version, scrounge up an old Shure-type carbon



mike case and buy a Shure VR dynamic mike cartridge for approximately $15. On the other hand, if you're out to save some pennies here and there, use a tiny 2½-inch transistor-radio speaker and contrive a housing from brass, aluminum, or tin-can scraps.

In either event, you can put the circuit together most easily on either a printed-circuit board or a cardboard chassis. In addition to the transistor, all you need is the speaker or VR unit and three ½-watt resistors.

In operation, current through the 27K resistor produces a voltage drop. This voltage powers the single-stage common-emitter amplifier. Bias for the base is fed through the speaker coil. Ac generated by sound striking the cone is superimposed on the dc bias, and the transistor amplifies this up to approximately 1½ volts RMS output for average speech.

Virtually any common PNP transistor will work in the circuit as shown; the 2N107 is ideal and was used often in the commercial version. By simply switching polarity of the power leads, an NPN unit can be substituted.

Note that neither side of the circuit is grounded; this enables the mike to be connected to its plug in such a manner that power polarity is correct without introducing signal-ground problems. Occasionally, shunting the 27K resistor with a 10 mfd capacitor may boost output; however, it's not usually necessary.

The Quaker Electronics Crystal Etching and Grinding Kit

THERE ARE MANY surplus crystals around that fall just outside the ham bands, probably because the hams have already bought up the ones inside the bands. These crystals, almost useless to hams, are available for a ridiculously low price because of the lack of demand. Some hams have tried grinding these crystals to raise the frequency slightly, but the grinding method makes it difficult to make small changes. Small changes should be made by the more controllable method of etching, since with this process it is possible, with some practice, to get a frequency within a few cycles. A new kit, manufactured by Quaker Electronics, Mountain Top, Pa., and selling for only $3.50, makes the process of changing crystal frequencies so easy that you really can't afford not to own one.

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The kit contains a package of Ammonium Bifluoride, used for etching the crystals, a package of grinding compound, six assorted crystal blanks, twelve assorted crystals in holders which can be modified for use on the ham bands or for practice, and the necessary tools.

With this kit it is possible to raise the frequency of a crystal from a few cycles to somewhat more than a megacycle. The crystal is ground until the area of the desired frequency is reached, and then etched to the exact frequency. Under some conditions this kit can even restore activity to somewhat inactive crystals.

The instructions are clear and well written, and good results can be obtained by anyone the first time. The instruction sheet has many hints in insure good results, as well as a diagram for a calibration oscillator.

The Ammonium Bifluoride can also be used to etch glass, numbers on tubes, etc. To do this, coat the glass object with paraffin and scratch the wax off where the etching is desired.

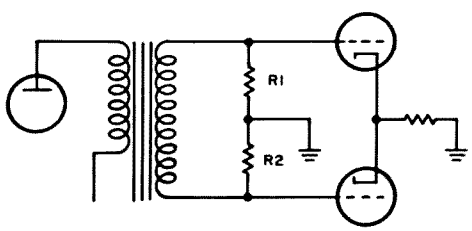
Results from this kit have been good. Several crystals were moved to within a few cycles of a frequency for VHF net operation and more moved from one part of the band to another.

This kit is quite a bargain at $3.50 and can be ordered from Quaker Electronics, Mountain Top, Pa. . . . WA2INM

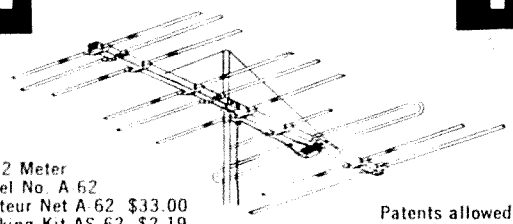
Push - Pull

Few hams are blessed with a well stocked junk-box or a surplus of cash. The idea presented here is intended to help you make use of what is in your junk-box.

The diagram hereabouts shows how a driver transformer with a single un-tapped secondary may be used to drive tubes in push-pull. Since the voltage across resistors R1 and R2 is equal to the voltage across the secondary of the transformer, the midpoint of the transformer can be grounded effectively by making R1 equal to R2 and grounding their junction. The effect is the same as with a center-tapped secondary winding, providing equal voltage to each grid. . . . W4JKL



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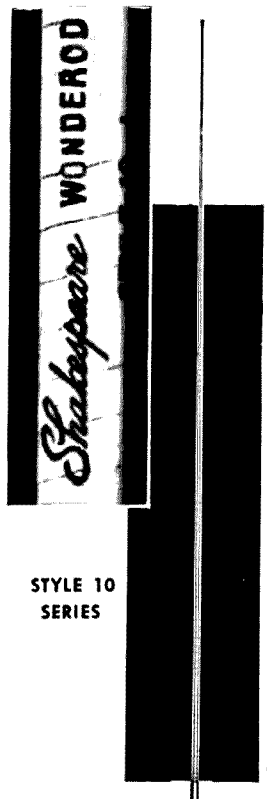
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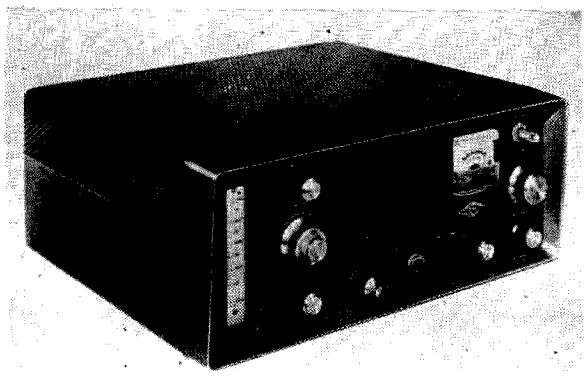
how WONDERODS beat "highway waggle"

You've seen it on the car ahead . . . maybe you even own a whip that lashes out like a run-away guillotine as your car reaches road speed. "Highway waggle" produces multiple vibrations, increases road noise — spoils reception.

A WONDEROD whip — Style 10 series — licks this problem with its Shakespeare construction. Inch for inch, fiberglass absorbs more energy — the factor that sets metal whips swaying.

—Besides, there's fewer inches in a WONDEROD than in metal antennas of comparable resonant length.

COLUMBIA PRODUCTS COMPANY
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Charles Spitz W4API
Associate Editor

73 tests the

Gonset Communicator IV-220

GONSET UTILIZED A LOT of engineering skill in producing six and two meter transceivers that were identical in appearance and performance. Now they have come out with a 220 mc Communicator that conforms to this pre-set pattern. In common with other Communicator models, the IV-220 is a transceiver in the functional sense only. It utilizes a separate transmitter and receiver with the only common portion being an audio section. Just like the six and two meter versions, the IV-220 has a directly calibrated and illuminated slide-rule receiver dial, geared by a dual ratio planetary drive for fast or slow tuning. The illuminated meter can be made to read signal strength, a frequency spot, or relative power output. The new model 3357 vfo shown in the photograph may be plugged into one of the six crystal sockets on the rear apron. The vfo dial is directly calibrated for the output frequencies of any of the Communicators, and even has a provision for FM!

Unfortunately the Gonset Company no longer gives out microphones as standard equipment, and this change has been carried over to the later two meter models. The IV-220 uses a standard three contact PJ-068 jack for the mike connector.

On older Communicators it was necessary to switch meter function between receive and transmit, and be restricted to push-to-talk operation. Not so on the IV-220! Transmitting on manual will automatically change meter function from S readings to power output. A spotting switch in the metering circuit shows not only your transmitting frequency, but the relative merit of your crystal by meter readings.

Receiver Section

There are many ways of arriving at 220 mc from some lower frequency, and the way that Gonset does it is interesting. The receiver portion of the system uses one of the new 6FY5 frame grid tubes as an rf amplifier, which is responsible for the low-noise front end. A 6J6 oscillator with an overtone crystal operating at 65.667 mc multiplies to 197 mc for injection into another 6FY5 which acts as the first mixer. The crystal controlled conversion thus achieved provides for excellent frequency stability. The second oscillator, a 7059 triode section, is tunable over the frequency range of 25.3 to 30.3 mc, and combines with the first *if* frequency of 23 to 28 mc. A 6AV6 is used as a second mixer, and produces a fixed frequency output of 2.3 mc. The pentode half of the 7059 second oscillator is used as another oscillator when crystal controlled fixed frequency operation is desired. These crystals may be selected from 6.9 to 8.566 mc so that they can be tripled to 20.7 or 25.7 mc for injection into the second mixer.

The 2.3 mc second *if* signal is coupled through a double-tuned bandpass transformer to the third mixer (a 6BE6) where it is heterodyned against a 2755 kc oscillator in order to produce the desired 455 kc third conversion frequency. Two stages of *if* amplifica-

tion are employed at 455 kc. Six tuned circuits in these stages are responsible for the outstanding selectivity. A vacuum diode (one-third of a 6AV6) is used as a detector, while the other portions are used as a rectifier to furnish delayed AVC to the rf amplifier. One-half of a 6AL5 is used as a conventional noise limiter, and the other half is used for squelch operation.

The triode section of the 6AV6 is used as the first audio amplifier. This audio is fed into the triode section of a 7059 in the modulator, and then into one of the 6BQ5 modulators that functions as the audio output amplifier as well. An audio jack is available on the rear apron and may be used for either headphones or external speaker.

Transmitter Section

The transmitter uses the plentiful and low priced 8 mc crystals or a vfo for the frequency source. The crystals connect to the input of a broad-banded 12BY7 that triples to 24 mc. A second 12BY7 triples between 73.332 and 75 mc, and is followed by a 6939 that triples to the 220 mc operating frequency. This signal then gets amplified by a pair of 6360's in push-pull. The Gonset people certainly had simplicity of operation in mind, because the only transmitting controls are plate loading and plate tuning.

The modulator uses the pentode section of a 7059 as a speech amplifier and the triode section as a phase inverter. The 7059 is followed by a pair of 6BQ5's operating in push-pull. This modulator is enough to provide 10 full watts of class AB_1 audio for real high level plate modulation.

The antenna changeover relay is built right in here, so it'll save you the expense of buying one.

Power Supply and Control System

Just as in the six and two meter models, the universal power supply uses two 2N1554 transistors for 12 vdc operation. Regular 117 vac can be used by merely changing the line cords in back of the set. The secondary winding of a two way power transformer feeds a power silicon diode bridge rectifier with a regular capacitor input filter. The push-to-talk relay changes the antenna connections between transmit and receive, as well as ^{B} plus from the modulator to the receiver, and ground from transmitter keying to speaker.

Observations

Even though the IV-200 was given its test

PREVERTER 50 & 144

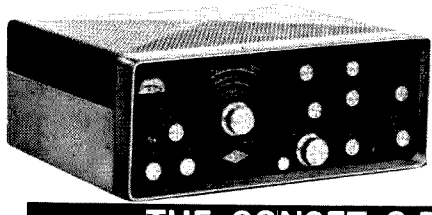


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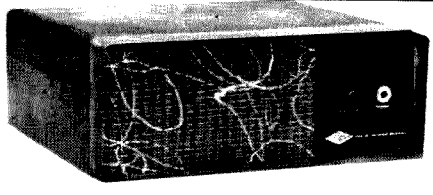
6 or 12 Meter model . . . **$14.95** post paid.



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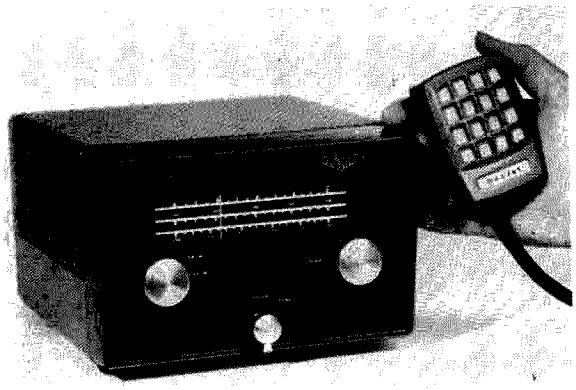
THE GONSET G-76 IS EQUALLY ADAPTABLE TO MOBILE USE OR FIXED STATION!



The G-76 operates on 6, 10, 15, 20, 40 and 80 meters. It is easily installed in vehicle, office or home. As a fixed station with AC power supply and speaker it is completely compatible with the 3357 VFO to provide amateurs with 6 meter band coverage.

For additional information contact your Gonset Distributor or write Dept. 73-11

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runs with a poorly oriented 12 element Yagi, good signals were sent as far as 50 miles. My thanks go to the many hams who unwittingly took part in the tests with their unsolicited observations and constructive criticisms, not realizing the help they were giving.

Many good 5 x 9 contacts were held with Ernie, W3UJG in Maryland, and with other hams through Virginia and the District of Columbia. To give an idea of band possibilities, W3UJG has been working twice a week schedules with W3ARW 120 miles away in Scranton. This has been going on for years . . . and they've never had any QRM.

Scope patterns were clean as on the six and two meter versions. A better than average converter was placed ahead of a 75A4 receiver, and pitted against the IV-220. Every station that was heard on the 75A4 was heard on the IV-220. Frequency readings were within the parallax of the dial configuration; for practical purposes it was as accurate as anyone could desire.

I suppose that if modifications were to be made, a bfo would be one of the first things on the list. It sure would help in locating weak stations and working CW. Many veterans of the band may applaud the fact that there is no gain control, but a screw driver adjust positioned to discourage the over-modulators would have been an aid to my weak voice, provided more gain were available.

All on-the-air reports were very good without having to solicit them. All controls function uncritically in a manner one would expect from low frequency professional equipment. Shorting the antenna terminals on receive did not disclose any self-generated birdies.

It cannot be emphasized too much that there is a lack of activity on the band. The band must see more operation if we are to keep it and we all can help by devoting some time to these higher frequencies of ours. I am sure the availability of the Communicator IV-220 will do much towards that end on 220 mc. Amateurs who have not ventured on the band will find much pleasure, companionship and the thrill of joining the pioneers in this portion of the spectrum. . . . W4API

Specifications

Frequency Range	:	219.7 mc to 225.3 mc
Frequency Control	:	Front panel selection of 6 crystals, 8 mc and/or external VFO
Final Power Input	:	20 Watts, DC Plate.
Power Supply	:	12.6 VDC; Receive 7.2 amps, transmit, 10.3 amps. 117 VAC; Receive 87.5 watts, transmit 110 watts.
Modulation	:	High Level, 10 watts, amplitude. 100% with high level clipping.
RF spurious and harmonic attenuation	:	Down 50 db
Tuning Indicator	:	Panel mounted meter for relative RF output or receive S meter.
Receiver Sensitivity	:	1.0 uv for 10db S/ N/N ratio.
Receiver Tuning	:	Rear apron switch for one fixed crystal frequency or manual.
Triple Conversion	:	1st Conversion crystal, 2nd manual tuning, 3rd six tuned circuits.
Spurious Rejection	:	Main image down 48db.
Noise and Hum	:	Down 40db
Squelch Sensitivity	:	0.1 uv to 50 uv
Audio Output	:	2 watts nominal
Dimensions & Weight	:	5" high, 12½" wide, by 11" deep. 21.8 lbs
Power Supply	:	2-way 117 VAC/12 VDC built-in, solid state.
Microphone	:	High impedance push to talk
Price	:	Model 3351 Transmitter-Receiver $394.50
	:	Model 3365 Universal Mounting Kit 3.95
	:	Model 3152 Telescoping Antenna 3.95
	:	Model 3363 Carrying Bag 12.00
	:	Model 3250 Ceramic Microphone 9.95
		Model 3357 VFO 69.50
Manufacturer	:	Gonset Divison, Young Spring & Wire Corp., 801 South Main St., Burbank, California.

In Defense of the Operator

Douglas G. Hedin KØOFB/2
219 Blanchard Blvd.
Syracuse 9, New York

"The amateur that does not build his own equipment does not deserve to have a license!" These sentiments echo mockingly through the hallowed halls of the best (and worst) radio amateur circles. Unfortunately, though they are uttered with deepest conviction, they are based more on misguided sentiment than on

considered judgement. A thoughtful glance at the past, as well as the present, will bear this out.

In the beginning, there was static, bits of galena, slop jars, and pencil-lead resistors. The only way to get an amateur rig on the air was to build it yourself, and more than likely you made most of the components too. Contradictory ideas were a dime a dozen.

For a while, as the pulse of technology quickened with new-found adventure, amateurs kept pace with it, building their own equipment and contributing as much to the fledgling science as they benefited from it. But as new rungs were added to the ladder of knowledge, the amateur soon found that he had neither the time to spend studying nor the money to spend on components in order to keep up with the Jack-and-the-beanstalk growth of electronics. At the same time, many of the amateurs at first drawn to amateur radio by the thrill of building equipment with which to communicate discovered even deeper satisfaction in the communications themselves. True, they came to build, but they stayed to talk!

As more amateurs shouldered their way onto the bands, equipment that was more dependable, stable, selective, and easy to operate was demanded. Also, the amateurs found that they had to consider the demands of their jobs, the needs of their families, and the limits of their pocketbooks. Against these they had to equate the love of their hobby. If they could not both build and operate, which should they do?

Such a choice undoubtedly is difficult. Those of us who once had the time to build remember with nostalgia absent-mindedly munching on a piece of insulation; watching the surface of a newly-soldered joint slowly shrink and change from shiny silver to mossey grey as the metal cooled; snipping off the excess wire from a new component; blowing the old solder off an "old faithful" that had been used again and again; drilling a jillion little holes in a circle or square because we didn't have a socket punch; or flipping the switch when it was finally finished, keeping one eye on the filaments and the other on the rectifier plates (hoping that the former would glow cherry red and that the latter would not).

On the other hand, there is the promise of that first hissing rush of electrons when the receiver is turned on; the cacophony of little sounds as the rig warms up; the beam, sweeping the horizon like a great electronic spyglass; the thrill of a new contact in another state or country; the warm voice of an old friend, perhaps never seen but as real and close as a brother; the walls and ceiling a patchwork quilt of 3 x 5-inch memories; and the pile of old logs stained with sweat and other liquids, and growing dumpy with age.

Yes, the choice is hard. But it must be remembered that the choice is ours to make, and we make it only because we must, not because we want to! . . . KϕOFB/2

ELIMINATE HETERODYNES

and other Unwanted Signals with

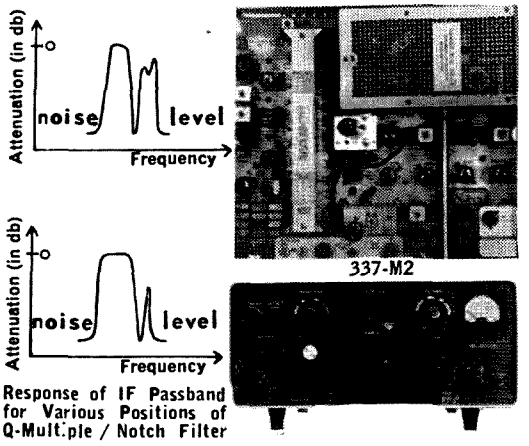
WATERS

Q-MULTIPLIER/NOTCH FILTER

The WATERS Q-MULTIPLIER/NOTCH FILTER will permit you to tune out annoying heterodynes. It gives a null of at least 40 db tunable across the entire IF passband.

The WATERS Q-MULTIPLIER/NOTCH FILTER combines an isolating amplifier and a tunable LC Bridged-T network with a Q Multiplier.

Designed specifically to fit the Collins 75S-1 or Collins KWM-2, the unit comes assembled ready for installation. Escutcheon plates and knobs are matched to equipment so there is no discernable change in appearance of equipment.



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3 Models Available:

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Catch All



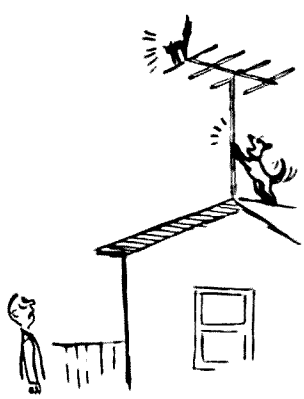




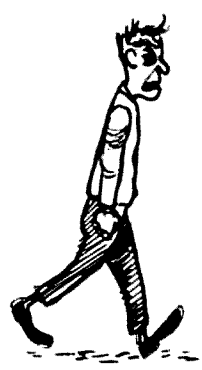


















Of RTTY – and Filters

Frank VanBrunt W3TUZ

Teleprinter operation by amateurs usually consists of the transmission of two frequencies, one separated from the other by 850 cycles. One frequency represents the mark signal and the other the space signal. With frequency shift keying (FSK) normal practice is to have the lower of the two frequencies as the space signal and the higher frequency the mark signal. The problem in reception is, briefly stated, to use specialized receiving equipment which, when the frequency representing the mark signal is received, provides current to the selector magnet of the machine and when the space signal is received cuts off the flow of current to this magnet. A filter (or a discriminator, which is basically a specialized form of a filter) must be used for separating this information. Our objective here will be to give some indication of the considerations that go into the choice of filter, and some help in getting a reasonably adequate filter operating.

One of the simplest systems to get operating is a system which uses only one of the two signals. Briefly, if you have an FSK signal being received by a receiver with either a 500 cycle mechanical filter or a good crystal filter you can tune the receiver so as to pass only one of the two signals. If you then rectify and filter the audio tone coming from the receiver you will have a dc signal that switches on and off depending on whether a mark or a space is being transmitted. This can then be amplified (by relays, tubes, transistors, or magamps) and used to control the printer. It has the virtue of simplicity, but unfortunately it also has the accompanying defects. It is quite sensitive to noise and to interference. It also discards half of the information being transmitted, a luxury we can seldom afford with the present level of ham band occupancy. Quite obviously the transmitting station could save power by merely transmitting either the mark or space only—this is sometimes done and is known as make and break keying (m.a.b.). Some countries do not permit amateur FSK operations and the hams are forced to this less efficient system.

Another relatively simple type of filter that is sometimes used is a cycle counter. This circuit, which is used in simple frequency meters, gives a dc voltage output which is proportional to the frequnecy of the input signal. This voltage output is fed to circuits which give a current *on* condition for a voltage output below a certain level and a current *off* condition for a voltage above a certain level. This level is adjustable and is normally set at an output voltage level corresponding to an input frequency half way between the mark and space output frequencies. The circuitry is simple, consisting only of resistors, capacitors, and tubes or transistors. No complex adjustment procedures are involved and it is quite tolerant of varying input frequencies and receiver drift. The very tolerance and simplicity which are so appealing are also the qualities which make it less than adequate. It is very sensitive to noise and interference, and while is does a good job when conditions are good, it fails dismally when the going gets rough. Somehow it seems the going always gets rough for me!

By far the most widely used filter systems are those which employ what is basically a discriminator. The simplest forms are those operating at the intermediate frequency of the receiver and having a peak to peak separation of about 1000 cycles. The circuits are substantially the same as conventional FM receivers and, unlike the two systems previously described, have the noise cancellation characteristics of FM discriminators. They can also tolerate a modest amount of drift and will work for signals ranging from relatively short shifts (short shift is the term usually applied to shifts of less than the usual 850 cycles) up to those with shifts of the order of 1000 cycles. This has considerable merit for even the most casual of

checks will indicate that while 850 cycles is generally accepted as the standard by the amateur fraternity, some of the gang only have a very foggy notion of what constitutes 850 cycles.

Receiving short shifts is a distinct advantage —you can copy some of the commercial stations using 425 cycle shift, and you can experiment with even smaller shifts. However, if your primary concern is with short shift signals, it would be far better to have a discriminator with a peak to peak separation of only 10% more than the desired shift. With this circuit the output voltage is proportional to the frequency shift from the center frequency, thus with a 1000 cycle discriminator being used on a 170 cycle shift signal, an interfering signal of equal strength but 500 cycles away from the center frequency will give far greater output voltage than the desired signal.

This technique has another disadvantage however—it won't work conveniently on an AFSK signal. You can, by careful tuning and continuous watching make it play, but in the process you lose the freedom from drift problem that make AFSK operation on VHF such a pleasant change.

The most widely used system is the audio discriminator type which uses one resonant circuit for the mark channel and another resonant circuit for the space channel. With relatively low Q resonant circuits this is substantially the same as the *af* discriminator (See Fig. 1). However, it does have the added advantage of being equally useful for both FSK and AFSK. With higher Q inductors you sacrifice the ability to operate with short shifts but you improve the interference rejection capabilities of the system, and at the same time decrease the effective bandwidth with a resulting increase in the signal to noise ratio. (See Fig. 1). The problem for the amateur RTTY operator has been twofold, first obtaining inductances with reasonably high Q, and secondly, actually tuning up the unit once suitable inductors had been procured.

As for inductors, some of the earliest units which were described used conventional chokes or transformers with laminations removed or

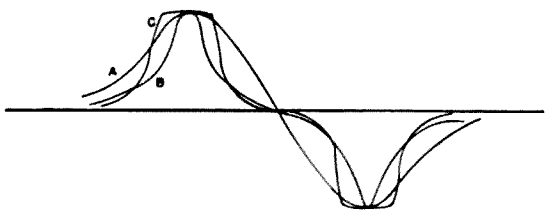


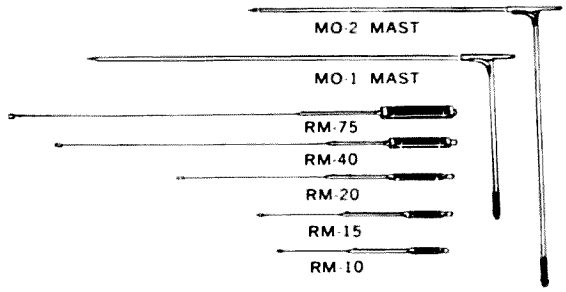
FIG. 1

Discriminator response curves:
a. Simple if type discriminator
b. Single toroid in each section
c. Double toroid in each section

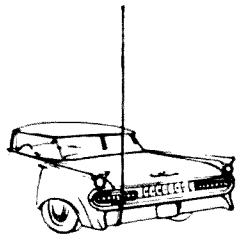
GOOD MOBILES GO

HUSTLER

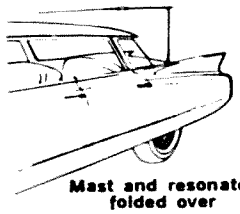
MOBILE ANTENNA
10-15-20-40-75- METERS



Buy only the mast and resonators for the bands you operate. NO NEED FOR MATCHING DEVICES, NO FEED LINE LENGTH PROBLEMS. Use any length of 52 ohm cable. New, efficient concept of center loading. Each resonator has a coil specially designed for maximum radiation for a particular band. Center frequency tuning is by an adjustable stainless rod in the resonator. The fold-over aluminum mast permits instant interchange of resonators. Mast folds over for garage storage. Mast has 3/8-24 base stud to fit standard mobile mounts, but will perform better with New - Tronic mounts. Power rating is 75 watts dc input A.M. - 250 watts PEP input for SSB.



Mast and resonator in mobiling position



Mast and resonator folded over

RESONATOR WILL WORK PROPERLY ONLY IF USED WITH MO-1 OR MO-2 MASTS. ANTENNA ASSEMBLY CONSISTS OF 1 MAST and 1 RESONATOR.

MODEL	DESCRIPTION	TOT. HGT. of ASSY.	NET
MO- 1	54" mast folds at 15" fr. base	Rear deck or fender	$ 7.95
MO- 2	54" mast folds at 27" fr. base	Bumper	7.95
RM-10	10 meter resonator	80" max. - 75" min.	5.95
RM-15	15 meter resonator	81" max. - 76" min.	6.95
RM-20	20 meter resonator	83" max. - 78" min.	7.95
RM-40	40 meter resonator	92" max. - 87" min.	9.95
RM-75	75 meter resonator	97" max. - 91" min.	11.95

ANY MAST OR RESONATOR MAY BE PURCHASED SEPARATELY

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otherwise modified. These were very low Q units and while some of them used multiple resonant circuits to improve the performance they were still relatively poor filters. A number of subsequent units used slug tuned inductors which were designed for television sets. While the Q of these inductances was reasonably good at higher frequencies, their Q and thus their resulting performance at 2125 and 2975 cycles was poor. The best Q and the best performance are to be had from molybdenum permalloy toroids. There are a number of possible sources for these toroids. If you are more affluent than the average ham you can go out and buy them with precisely the inductance you desire for a price between $5 and $10 each. A second alternative is to buy the cores for about $1 each and wind them yourself. It is not particularly difficult and you can get precisely the values you want. A third alternative is to find some surplus filters which have usable toroids in them and disassemble the filters. This technique provided about 300 excellent toroids for the local gang at a cost of less than 25¢ a doughnut. This I might add was the result of a trip down radio row buying a sample of every likely looking filter, then taking them home and unpotting them to find what was inside. The last and most common source of these toroids is the 88 mhy loading coils that are used by telephone companies in large quantities. These are widely advertised and in small quantities cost on the order of $1 each. If you are alert and find a junkyard with large sealed cans of these the costs can be cut significantly—you will end up doing a considerable amount of labor and have an awful lot of toroids on hand.

So much for supply problems, back to performance. The 88 mhy units used in a single resonant circuit for each of the two frequencies have a number of drawbacks. The response is more sharply peaked than is desirable for general use. Ideally this could be improved by using larger inductances which would result in a higher L/C ratio—inductances of 500 mhy or so are better in single tuned circuits. Another drawback is the fact that using the same value of inductance in each resonant circuit results in a L/C that is significantly different in the two circuits (by a factor of about 2/1). An added source of variation is the change in Q of the inductors as a function of frequency.

Ideally one not only wants the peak output of each of the two response curves to be equal in value (and this condition is readily achieved by adjusting the inputs of the two circuits), but you also want the area under the two curves to be equal. The latter requirement will result in optimum noise cancellation in the output of the discriminator. This assumes, of course, that by noise you are referring to an input which is stochastically distributed within the relevant frequency limits.

The next step toward this ideal and toward improved performance is to use a more complex filter. The most common is a simple filter using two toroids in each channel with capacitive coupling between the two resonant circuits. This is just two resonant circuits in which the over coupling is adjusted to broaden the response curves so that the bandpass in both the mark and space channels are the same. This type of filter has been widely used and was discussed in detail some years back by Bob Breitbach (WφNRM) in an article in RTTY News. The basic filter with the appropriate values is shown in Fig. 2. The values given are

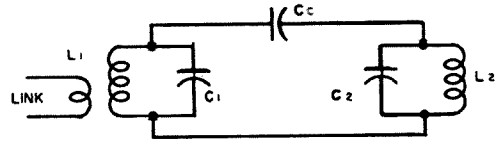


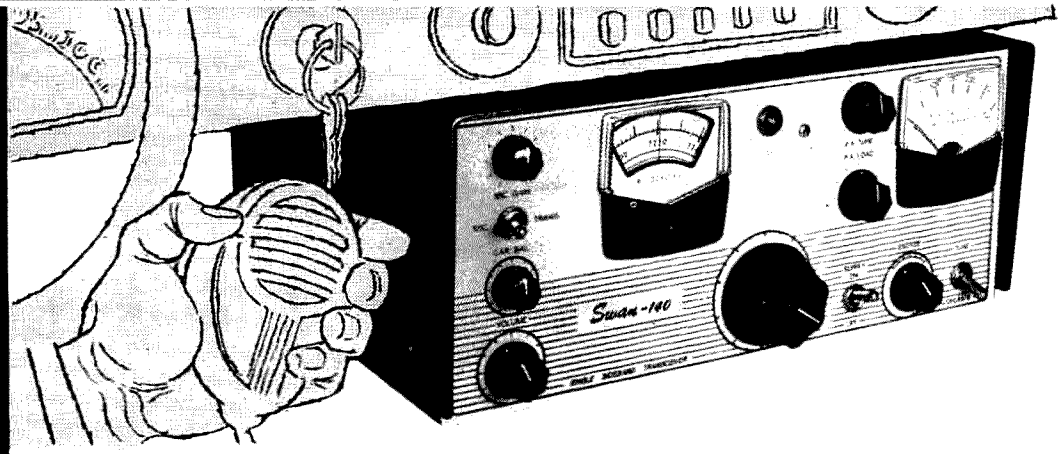
FIG. 2

	L_1 & L_2	C_1 & C_2	C_c	Link
2125 cps	88 mhy.	.06	.0059	9 turns
2975 cps	88 mhy.	.03	.0022	5 turns

for a bandwidth of 200 cycles. This bandwidth is recommended for general operation, and represents a compromise between a desire for a better signal to noise ratio and better rejection of interfering signals that results from a narrower bandwidth—and the ease of tuning, tolerance of moderate drift, and ability to accept inaccurate shifts that result from wider bandwidths. If you have a good stable receiver and don't mind retuning now and then you can use a narrower bandpass.

The question often arises as to how narrow a bandpass can be used, and considerable controversy, information, and misinformation have been published on the subject. This will in fact depend on the signal to noise ratio, the printer speed (baud rate), the characteristics of the filter you use, the number of errors you are willing to tolerate, and the signal processing after the filter. For the average ham the only two factors he can control in his terminal unit are the filter characteristics and the signal processing after the filter. There are commercial equipments on the market which transmit information at baud rates which are greater than the bandwidth (in cycles) of the circuit, and there are many equipments where this ratio is almost 1:1. Thus it should be feasible (since amateur operation is at 60 wpm or about 45 bauds) to use filters which are considerably sharper than the 200 cycle figure suggested for general use. The error rate a ham can tolerate

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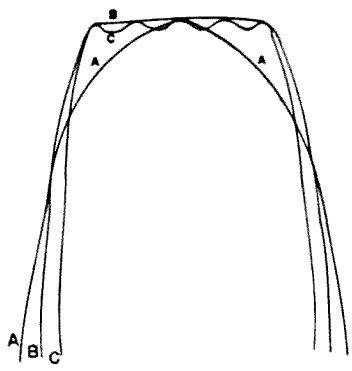
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(or for that matter be quite pleased with), is far higher than would be considered acceptable in normal commercial practice. Luckily languages have a relatively large order of redundancy and an error in one letter of a word now and then does not normally destroy the meaning of a sentence.

When one starts considering sharp filters another factor becomes important: these filters do not merely have to discriminate between two frequencies, they must respond (and the faster the better), to pulses of the given frequencies which at the fastest reversal rate are 22 milliseconds in length. If the risetime of the filter is too long relative to the pulse length, you will have poor performance regardless of the fine shape of the steady state frequency response curve. You can design three basic types of filters, the most common being the Butterworth or maximally flat amplitude response type. These have a flat response across the top and relatively steep skirts. A second type is the Chebyshev*, which is becoming increasingly popular. Briefly put, if you are willing to tolerate some ripple across the pass band of the filter, you can achieve better skirt selectivity characteristics; and the more ripple you can tolerate the steeper you can make the skirts. The third class of filters are those designed for maximally linear phase variation across the passband of the filter. This type does not have as steep skirts as either of the other types, and it does not have a flat amplitude response across the passband—it is in fact peaked in the center of the passband and falls off gradually toward the edges of the passband. It does have a significant advantage, it has a faster risetime than the other types of filters and hence is more appropriate for use with pulse inputs. It is also less subject to ringing



Filter response curves:
a. Maximally linear phase design
b. Butterworth (maximally flat amplitude)
c. Chebyshev

*The spelling varies considerably, depending on how you transliterate the Russian.

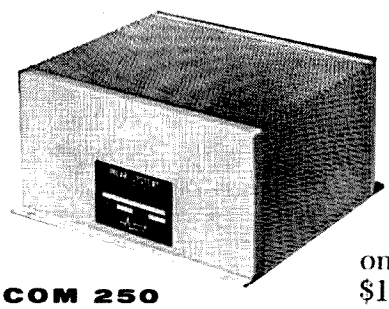
which often becomes a significant problem with sharp, steep sided filters. If you want to try better filters than the simple two section variety described earlier, by all means use the maximally linear phase characteristic. Detailed design procedures would be much too lengthy to go into at this time but an excellent summary and the necessary tables can be found in "Reference Data for Radio Engineers" *Fourth Edition*, published by I.T.&T. The information is *not* in the third edition.

A number of articles on filters have asserted that, since the objective was to recover from the two tones information in the form of 22 millisecond pulses, and since in the fastest possible case—successive mark space signals (reversals) this was in fact a square wave of about 23 cps.—and that you had to recover the third order products in order to reasonably reconstitute this square wave which was being transmitted. The argument then continued that since this involved both sidebands on each side of the center tone frequency, that the bandwidth of the filter had to be at least twice the third harmonic of 23 cps and that therefore the minimum bandwidth that could be used was of the order of 135 or 140 cycles. This argument is only valid if you have no provision for pulse reshaping following the discriminator.

Each audio tone may be considered as consisting of a carrier on the particular center frequency (2125 or 2975) which is modulated by a square wave. At the fastest reversal rate you have 22 millisecond pulses or a square wave of approximately 23 cycles, this is approximately what you have when RYRYRY . . . is being transmitted. The average modulation rate is lower than this, but this represents the maximum requirement of the system. This square wave produces the usual Fourrier series of sidebands, thus you have the 2125 cycle carrier, the first order sidebands at 2125±23 cycles, the third order sidebands at 2125±3x23 cycles, and all the rest of the odd order sidebands. The major portion of the energy is in the carrier and the first order sidebands, with decreasing amounts of energy in the higher order sidebands.

We can separate the input to the filter into three basic components: the tone carrier, noise (by which we mean stochastically distributed inputs), and interference (by which we mean signals with a coherent frequency distribution which may appear within the passband of the filter). When we narrow the bandpass of the filter we are affecting all three inputs: 1. We are discarding higher order sidebands of the desired signal; 2. We are decreasing the noise,

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and 3. We are decreasing the probability of receiving an interfering signal. The first mentioned effect is the price we pay for the advantages of the last two. When we go from a filter that passes the fifth order sidebands to one that passes only the third order sidebands we find we have decreased the noise to 60% of the former value and the probability of interference by the same amount, and since the loss in information in the fifth order sidebands is not this large we increase the signal to noise ratio and the efficiency of the system. Now if we decrease the filter from a bandwidth that passes the third order sidebands to that which passes only the first order sidebands we have decreased the noise by a factor of three, the probability of interference by the same amount, and the information we have lost is substantially less than this amount. Don't try to take it any further or you start losing ground. Note that the modulation rate is not normally the 23 cycle square wave, it actually varies from nearly zero to this figure, and with quite a number of ifs thrown in this represents the limit of a function. This is not to imply that you can't go further—there is a theorem in information theory that says you can transmit an infinite amount of information in an infinitely small bandwidth if you have an infinitely high signal to noise ratio. The last is what you don't have. Even to go to the limit indicated of a 46 cps bandpass which recovers only the first order sidebands would require perfect stability, excellent filters, and the best in signal reprocessing techniques.

Any terminal unit of reasonable design will, in fact, incorporate some facility for pulse reshaping—perhaps the most common and elementary device is a relay. With inputs above a certain level this will be on and at inputs below a certain level it will be off, and if you feed low frequency sine wave input to it you will get a square wave out of it. There is in fact no requirement for a reasonably square wave input. It has the obvious disadvantage that the hysterisis or difference between pull in and drop out levels is too great and that the adjustments of the characteristics are usually mechanical and extremely difficult. Because it is a mechanical conversion device the speed at which it reacts is limited. Further it tends to stray from optimum adjustment over time and has contacts which generate a species of noise which is very difficult to eliminate.

The same object can be accomplished electronically, and it can be done in a fashion so that the action can be readily adjusted and the noise of mechanical contacts eliminated. Probably the simplest electronic means of reconstituting a square wave is to overdrive an amplifier that is fed by the degraded waveform. This technique has been widely used and while it gives relatively good square wave output it lacks flexibility, and it is possible with certain settings to get intermediate outputs which are neither on nor off. A better technique—which can be easily adjusted over a wide range and gives only on and off outputs—is the Schmitt trigger. These can be readily built with either tubes or transistors (although with this circuit the transistor version is simpler and easier to work with).

Fig. 3 gives an excellent illustration of the action of a Schmitt trigger when the trigger level is varied over the operating range. Here the positive direction corresponds to a mark signal and the negative direction to a space. Levels A, B, and D give misprints, while setting C gives a practically perfect letter F. I confess that when one draws illustrations one tends to stack the cards—but its function in actual practice is equally impressive. Note here that regardless of the input voltage wave shape that the output from the trigger is a perfect square wave. The filters do not have to deliver a reasonably square output—they merely have to separate the input signal into two channels and deliver the resulting outputs to the discriminator. The Schmitt trigger then electronically makes the decision as to whether a mark or a space is being transmitted. This decision is based on the relative amplitudes of the outputs of the two channels. The bias level setting compensates for continuous unwanted signals in either channel, or in the case of AFSK for variations in the levels of mark and space tones

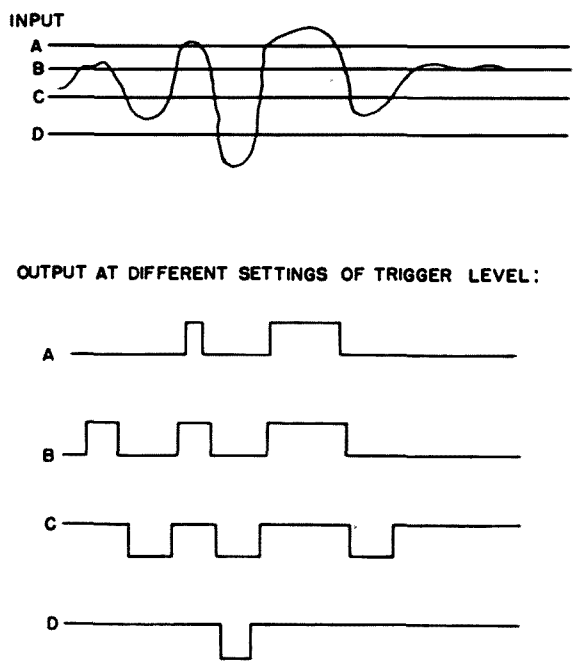
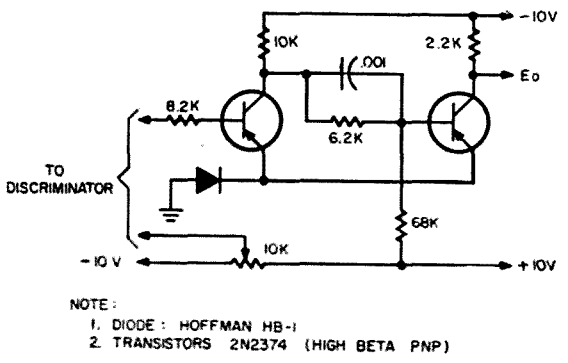


FIG. 3



NOTE:
1. DIODE: HOFFMAN HB-1
2. TRANSISTORS 2N2374 (HIGH BETA PNP)

FIG. 4

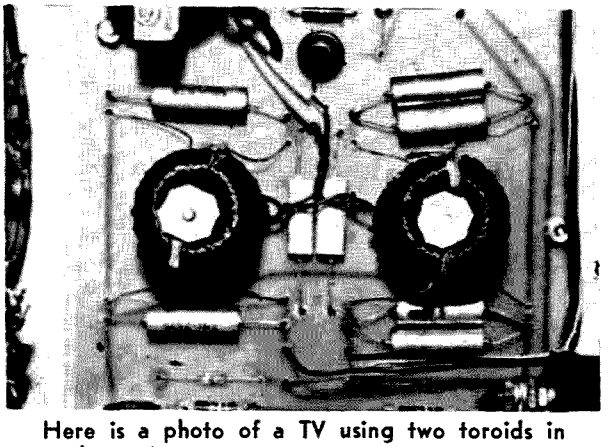
being transmitted. (This varies more widely than you would suspect, having these within 25% is better than par for the course.)

Fig. 4 gives the circuit of a typical transistor Schmitt trigger. The trigger level without the bias potentiometer is about —.8 volts, but with the variable bias this point may be varied over a ±10 volt range. Provision should be made in the terminal unit to insure that the discriminator output voltage range does not exceed this 20 volt peak to peak range. In actual practice there is a small amount of hysterisis in the circuit, the output flips to the on condition when the input exceeds —.83 volts and turns off when the input falls below —.80 volts. This difference of .03 volts is of no import when compared with the 20 volt range of the input from the discriminator. Compare this with the typical relay which has a 2:1 range between pull in and fall out.

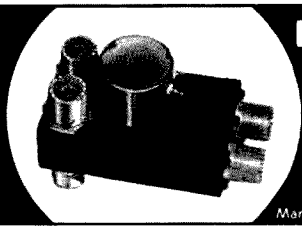
It should be noted that even if no explicit restoration technique is used in the terminal unit, you will get it in the printer as a result of the action of the armature of the selector magnet of the machine. This is the poorest of all techniques, adjustment will be critical, and the range of the machine will be very narrow. This function should be provided in the terminal unit, should have minimum hysterisis, and should have as wide a range of adjustment as possible.

The next step, once you decide on the filter you want, would logically be to tune up the filter. But for those of you who don't have counters available it might be best to turn your attention to some sort of frequency standard. If tuning up the filter is going to be a one shot affair the most reasonable procedure is to use the standard audio tones broadcast by WWV or one of the other standard frequency stations, along with an oscilloscope to give you the appropriate Lissajou patterns and after your audio signal generator has warmed up completely calibrate it as accurately as possible in the 2000-2250 and 2850-3100 cycle regions. For those who desire greater precision than this or plan to do an appreciable amount of work, either borrow from one of the local gang or build a standard for the common RTTY frequencies. There are two types of standards in use, both of which do an admirable job. The first and most common—although not the easiest to build is the tuning fork standard. This uses a tuning fork as a resonant element and normally operates on a frequency of 425 cycles. These are made with standard 435 cycle tuning forks which have been lowered to 425 cycles either by loading the ends of the tynes with solder or by filing the crotch of the fork. There have been a number of articles published on building these and they serve admirably for tuning up filters and checking RTTY equipment. With an oscilloscope they give you 5:1 and 7:1 Lissajou patterns with the standard 2125 and 2975 frequencies. They are also handy for setting the 850 cycle shift in FSK operation. The alternative approach is to build a crystal oscillator for 446.25 kc (there are standard surplus FT-241 crystal units that are approxiamtely this frequency and they may be easily brought to precise frequency by edge grinding the crystal). The oscillator is followed by two successive multivibrator dividers—the first dividing by 6 and the second dividing by 5. The end result is a standard frequency of 14,875 cycles. This, too, gives the 5:1 and 7:1 Lissajou patterns with the standard frequencies. If you intend to do much RTTY work, they are handy gadgets to have about the shack.

The next requirement is a voltage indicator, if you are using a counter or a well calibrated audio signal generator a good ac VTVM is all that is needed. If you are using one of the frequency standards an oscilloscope is highly desirable since you can check amplitude and frequency at the same time. The basic set up is to feed the output of the audio signal generator through an isolating resistor to the circuit under test, and in turn, through another isolating re-



Here is a photo of a TV using two toroids in each section.


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sistor feed the Y axis of the oscilloscope. (See Fig. 5). The two resistors should be 1 megohm or higher. The standard signal generator should be fed to the X axis of the scope to permit observation of the Lissajou patterns for calibration purposes. With this set up you tune the circuit for resonance (which is indicated by maximum amplitude) at the proper frequency (which is indicated by the Lissajour patterns).

Tuning the circuits to resonance is naturally the basic process of varying L or C. With the usual 88 mhy toroids there is usually not much variation from one unit to the next—they seem to be wound to relatively tight tolerances. The easiest method by far is to have a large number of capacitors of approximately the correct value and just keep trying different ones until you find the right value. The typical spread on capacitors is fairly wide and the selection process is fairly simple. A similar technique which requires fewer capacitors is to use two capacitors to get a given value—the .06 mfd that is needed to tune up the 2125 cycle unit may be obtained from an .01 and an .06 in parallel, and resonance can be achieved from a relatively modest supply of each by successively trying various combinations of the two. Of course, if a given capacitor falls slightly below the desired capacitance a small capacitor can be added for precise resonance. If your stock of capacitors is small, the easiest adjustment is in the number of turns on the toroid. It is easy to add a few turns or peel off a few to tune the circuit to resonance.

A simple two toroid filter and approximate values were given in Fig. 2. There are two basic ways to attack this problem. The first, and most elegant, is to tune both L_1C_1 and L_2C_2 to a frequency of 100 cycles (i.e., half the desired bandwidth of the filter) higher than the desired center frequency. In this case the frequencies would be 2225 cycles for the pair intended for the mark filter and 3075 cycles for the pair intended for the space filter. If you have a 425 fork standard you will find it quite convenient to use a 21:4 Lissajou pattern, which gives you a frequency 425/4 or 106 cycles high. On the space filter use a 29:4 Lissajou. Then assemble the filter and try successive values of coupling capacitors—the correct value will extend the passband of the filter to the desired limit on the lower side of the center frequency. The larger the value of coupling capacitor the wider the bandpass of the filter. For narrower filters, the pairs are initially tuned to frequencies closer to the center frequency and the coupling capacitors are not as large. An excellent approximation of the coupling capacitor can be obtained by shunting a single LC circuit with the coupling capacitor—the circuit should then tune to the center frequency.

The other method is to select the value of the coupling capacitor (C_c in the table) and tune each pair individually to the center frequency. Thus you will first resonate $L_1(C_1+C_c)$ to 2125 cycles, then remove C_c from this circuit and resonate $L_2(C_1+C_c)$ to 2125 cycles, and finally assemble the filter in the final circuit configuration. This is easier than the first method and only requires the use of the 2125 cycle reference frequency rather than shuttling back and forth between the two sides of the center frequency. This procedure should best be followed with the filter in place or at least with the operating load circuit connected since when it is actually installed there will normally be added capacitance across at least the last of the two toroids. Merely shorting out the toroid not being tuned will place the coupling capacitor across the appropriate resonant circuit.

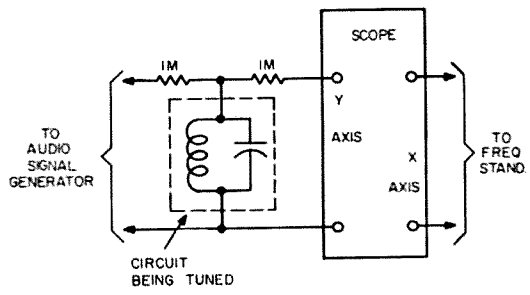


FIG. 5

You will quite probably find when you have finished the tuning that the pass band is not flat—this will depend on the loading of the filter. The response can be smoothed out by adding a resistor across the final toroid. Do not do this until it is installed in the operating circuit, however, since this may provide sufficient loading. If you still have a double humped response add a resistance of whatever value is required to smooth out the response. This value of resistance will not be the same for both the mark and the space filters, since the loads will be approximately the same for the two while

their impedances vary by a factor of about 2:1.

The values given are for the standard 88 mhy units but if you have other toroids you can merely adjust the capacitance values by the appropriate ratios and use the same tuning procedures. If you have different inductance toroids you should use the larger inductances in the 2125 cycle filter and the smaller inductances in the 2975 cycle filter.

The input to the filter is easily accomplished by winding turns on the toroids. The output section preceding the filter should use a plate to voice coil or collector to voice coil transformer—the voice coil winding provides matching to the links wound on the toroids. The number of turns on the links are adjusted to give equal output from each of the two filters. This adjustment, while not difficult, is important since the outputs of the two filters are so arranged that when there is an interfering signal or noise with equal amplitude in both channels the resultant outputs cancel. We found 9 turns on the 2125 filter and 5 turns on the 2975 filter gave these desired results, but you should check the performance before you consider the job complete.

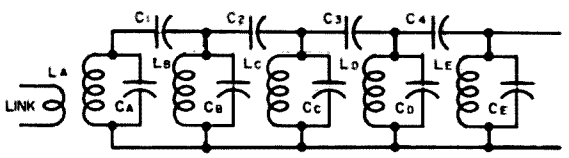


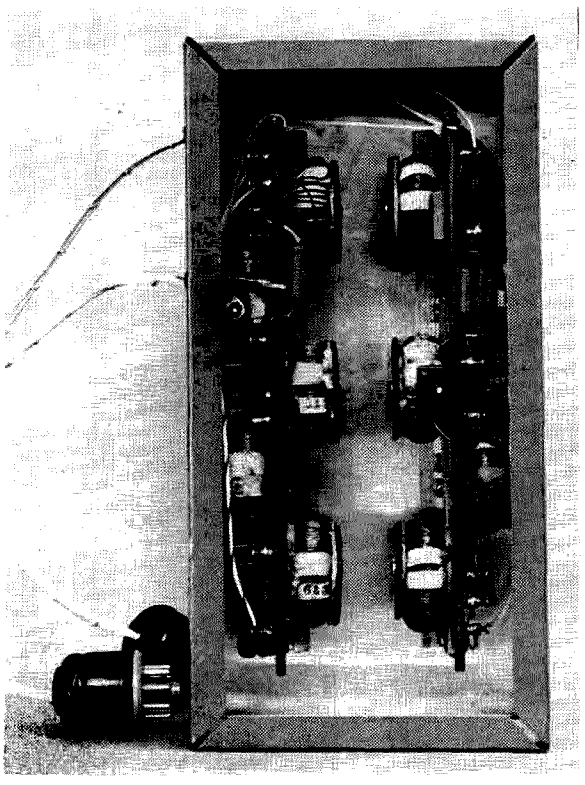
FIG. 6

freq.	C_1	C_2	C_3	C_4	(Approx.) C_{a-e}
2125	.0074	.0037	.0026	.002	.06
2975	.0025	.00125	.0009	.0007	.03

Values for 85 cycle bandwidth, maximally linear phase response, using 88 mhy toroids

The next step in order of effectiveness, and of complexity too, is the use of multisection, maximally lienear phase filters. I might comment though that getting set up to tune filters is the major chore, and the actual tuning is a relatively straight forward and not particularly time consuming task. These filters may be designed for as many sections as you wish, and for whatever bandwidth is desired. The one we built up used five toroids in each channel and the basic circuit is given in Fig. 6. The bandwidth chosen, 85 cycles, is compromise between the requirements for optimum signal to noise ratio and interfence rejection capabilities, and the necessity of accommodating a moderate order of drift and not have hypercritical tuning requirements. The performance is excellent, particularly when the going gets rough. The skirt selectivity is impressive indeed and in practice the tuning is not particularly difficu't. The tune up procedure is the same as that outlined in the latter part of the discussion of the procedure for two section filters. The values of C_1, C_2, C_3,C_4 are not critical and are either ordinary 10% tolerance units or combinations of them. Mount and wire up the filter with the toroids and coupling capacitors in place. For a convenient mounting, ordinary terminal boards serve nicely with the terminal points providing mountings for the capacitors and the toroids mounted on alternate sides of the board. One note of caution on mounting toroids in general—don't have them completely surrounded by metal—it is equivalent to a shorted turn and the performance (if you can discern any!) is very poor. To tune up the first section, short the second section and tune the first using the same set up described before—either by varying the capacitance or adjusting the turns on the toroid. When this is completed remove the short from the second section, short the first and the third section and proceed to tune up the second section. The successive sections are then tuned up in precisely the same manner, always making sure that the short has been removed from the section you are tuning and that the two adjacent sections are shorted. For the final section, which when the filter is operating will be connected to additional load—it is best to tune this after the unit is connected to the terminal unit. The coupling is accomplished in precisely the same way as before—in fact, you can try the same number of turns suggested before as a starting point. Although the values given here are for 88 mhy toroids, other values can be used by making the proportional changes in capacitance. This assumes that the Q of the toroids you use is not too far off from those of the 88 mhy units; the design of the linear phase shift filters is based on the Q of the toroids as well as the frequency and bandwidth of the filters.

A further point to note is implicit in the tune up procedure. C_a has C_1 in parallel for resonance, C_b has C_1 and C_2 in parallel, and so on—hence the values of capacitance will not be the same for C_a through C_e. The actual values may readily be computed since you need .064 mfd to resonate 88 mhy at 2125 cps and .033 mfd to resonate 88 mhy at 2975 cps. Thus the actual values will run under the approximate values given. This has the merit of using different values for each capacitor—the probability of your having a quantity of identical value capacitors is relatively small. Some mention should also be made for those few of you who will actually consult the references given on these filters. The standard design lists a resistor across L_a to degrade the Q of this section for optimum phase performance. In actual practice the loading by the input circuit takes care



A five section maximally linear phase filter. This does not use 88 mhy toroids but the techniques are identical and the L/C ratios are appropriately scaled.

of this problem handily, but if there is any doubt as to whether you have enough turns on the input link—by all means err on the side of overcoupling.

The filters were made on the terminal boards mentioned before, and after the filters were tuned they were both mounted beneath a 5x10x3 chassis with 4 leads 10 inches long coming from each filter to an octal plug. By removing the regular two section filters (which were mounted in Vector C-12 cans with octal bases) and plugging in the two octal plugs we are able to convert from the broad to the sharp filters in a matter of seconds. Since our terminal unit is built on a 5x10x3 chassis also, we merely place the t.u. on top of the filter and have a very compact unit. (See Photo).

You will find the performance of this filter decidedly better than the simple two toroid filter. The passband is adequate for good performance and the unit has high selectivity without the attendant ringing of other designs. If you use the conventional scope tuning indicator with the output of the mark channel to the horizontal plates of the scope, and the space channel to the vertical plates of the scope, you will note that the lines are considerably sharper with this filter. In addition, since the passband is not flat but is slightly peaked in the center (the 85 cycle bandwidth figure here specifies the width to the −3 db points) the tuning is actually easier in some respects since there is no ambiguity in the setting. However, don't throw away your old filters, there will be times when you need them—particularly when the other station is using only a rough approximation of 850 cycle shift. The ideal arrangement would be one in which you could merely switch from the two section to the five section filter—however, in actual practice we have found the plug-in technique quite adequate.

We have mentioned short shift a number of times and you might wonder why—if you can in any case build filters with bandwidths on mark and space, respectively, equal in width to those used on short shift signals—there should be any advantage in using short shift. The most significant advantage in short shift is a result of the propagation characteristics of electromagnetic waves; the closer two frequencies are to one another, the smaller the probability of selective fading. Since the basic method of detecting the RTTY information is to make a decision based on the relative signal in the two channels, it is desirable to have a minimum amount of selective fading. Another advantage for many is the possibility of supplementing the selectivity of the terminal unit with the more selective *if* filters which are found in the better ham receivers. A further advantage is the possibility, with the more compact signal that results, of avoiding certain types of interference.

An advantage of the plug-in technique used for the filters we have mentioned is that you can build up one extra section for short shifts. If you have filters for 2125 and 2975 and are interested in short shift, say 170 cps, you have only to build a unit for 2295 cps and use it in conjunction with the 2125 cps unit for this short shift work. In addition you may also want to build a unit for 425 cps shift for copying a number of the commercial stations using that shift.

The first filter is the hard one—once you've gone through the procedure the rest are easy and the returns in terms of actual on-the-air performance are impressive. If more attention is turned to putting together a satisfactory terminal unit with adequate filters you will get much more effective and much more enjoyable RTTY operation.

For the adventurous—and for those who don't like graphs, mathematics, and such, I have included Figs. 7, 8 and 9. These give design data for 3, 4 and 5 section maximally linear phase shift filters, with a choice of bandwidths which you can use according to your receiver stability and personal tastes and inclinations.

I suspect it will save a number of inquiries and make life a little easier for those who want to strike off on their own. I might comment that one of the reasons both the maximally linear phase shift filters and the Chebyshev filters were not more widely used before was the mathematics involved. More recently tables have been complied which make the procedures far easier and in addition, the advent of electronic computers that make formerly impossible tasks merely the subject of a modest amount of machine time have changed these from the realm of interesting theoretical possibilities or the objects of arduous cut and try procedures into relatively common everyday items.

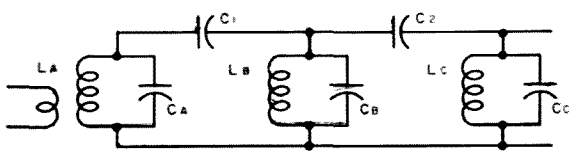


FIG. 7

Width	Freq.	C_1	C_2	C_{a-c}
60	2125	.0027	.0014	.06
60	2975	.00082	.00048	.03
85	2125	.0043	.0021	.06
85	2975	.0014	.0008	.03
120	2125	.0062	.003	.06
120	2975	.0021	.0011	.03

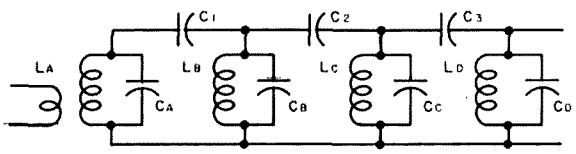


FIG. 8

Width	Freq.	C_1	C_2	C_3	C_{a-d}
60	2125	.0038	.0020	.0014	.06
60	2975	.0011	.00064	.0005	.03
85	2125	.0058	.0029	.0020	.06
85	2975	.00195	.0010	.0007	.03
120	2125	.0087	.0042	.0029	.06
120	2975	.0029	.0015	.00105	.03

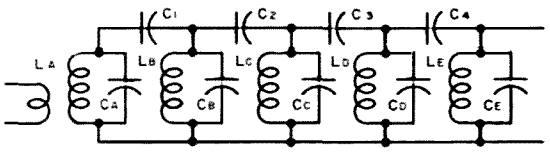


FIG. 9

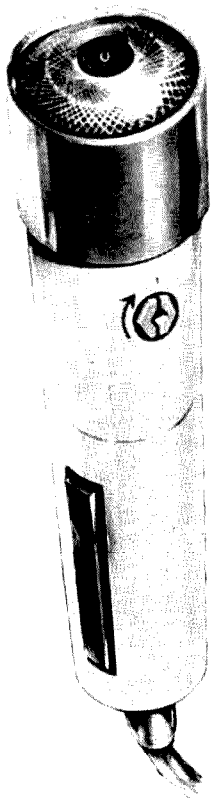
Width	Freq.	C_1	C_2	C_3	C_4	C_{a-e}
60	2125	.0049	.0024	.0018	.0014	.06
60	2975	.0015	.0008	.0006	.0005	.03
85	2125	.0074	.0037	.0026	.002	.06
85	2975	.0025	.00125	.0009	.0007	.03
120	2125	.0113	.0055	.0038	.0029	.06
120	2975	.0039	.0019	.0014	.0010	.03

. . . W3TUZ

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Premium Tube Replacement Guide

Roy Pafenberg W4WKM

THERE is a seemingly endless series of "four digit" tube types designed as "premium," "reliable-ized" and "rugged-ized" replacements for the more common types. The listing presented here is compiled from many sources and is designed for the amateur. That is, it is a "one way" list showing which of the more common tubes will plug into those "four digit" holes in surplus equipment and pointing out the more obvious uses for the "four digit" tubes that are flooding the surplus market.

Although care has been taken in the preparation of this listing, much of the source material could not be verified from available references. Also, caution must be exercised in using the list. Minor differences, both electrical and mechanical, exist between many of the types listed. Therefore, in critical applications, any substitution should be made on a "try and see" basis.

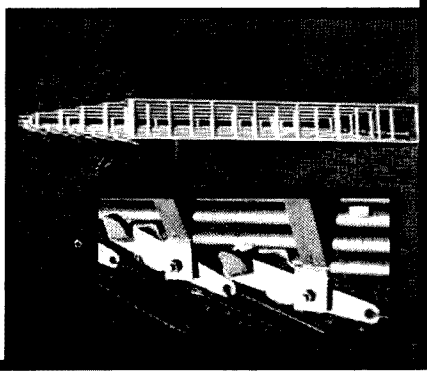
Premium Tube	*Prototype*
1201	7E5
1221	6C6
1267	OA4G
1291	3B7
1293	1LE3
1294	1R4
1299	3D6
1603	6C6
1609	6J7
1612	6L7
1613	6F6
1614	6L6
1620	6L7
1621	6F6
1622	6L6
1629	6E5
(1629 is 12.6 volt filament version of 6E5)	
1631	6L6
(1631 is 12.6 volt filament version of 6L6)	
1632	12L6GT
1634	12SC7
1635	6N7
(6N7 filament current is 33% higher and plate load resistance is 33% lower)	
1644	12L8GT
1852	6AC7
1853	6AB7
5591	6AK5
(6AK5 filament current is 16.6% higher)	
5602	12AT7
5608	6AK5
5651	OA3
5654	6AK5
5659	12A6
5660	12C8
(12C8 transconductance and screen voltage rating are 25% higher)	
5661	12SK7
5670	2C51
(2C51 filament current rating is 14% lower)	
5679	7A6
(5679 has added filament center tap)	
5691	6SL7
(5691 has .6 A heater and plate dissipation rating is slightly less)	
5692	6SN7
(5692 plate dissipation rating is 30% less)	
5693	6SJ7
5694	6N7
(5694 has separate cathode connections) &	
5719	6AD4
(6AD4 transconductance is 17% higher and grid to plate capacitance is 12% lower)	
5721	6AU6
5725	6AS6
5726	6AL5
5727	2D21
5731	955
5732	6K7
5749	6BA6
5750	6BE6
5751	12AX7
(12AX7 filament current rating is 14% lower, transconductance is 33% higher and amplification factor is 43% higher)	
5755	6SU7
5764	2C37
5765	2C37
(Electrode rings differ)	
5766	2C37
(Electrode rings differ)	
5767	2C37
(Electrode rings differ)	
5784	6AS6
5812	2E30
5814	12AU7
(5814 has 16% higher filament current rating)	
5824	25B6G
5838	6X5GT
5844	6J6
(5844 has 33% lower filament current rating, 26% lower amplification factor and 30% lower transconductance)	
5852	6X5GT
5871	6V6GT
5873	12AU7
5881	6L6WGB
5910	1T4
(1T4 plate and screen ratings are 18% lower)	
5915	6BE6
5920	6J6
(5920 is ⅜" longer, has 10% lower heater current rating and 34% lower amplification factor)	
5930	2A3
(5930 has .3" greater base diameter)	
5931	5U4G
5932	6L6GA
5933	807
(5933 has .3" greater base diameter)	
5961	6SA7
5964	6J6
(5964 has 14% higher transconductance and 20% lower output capacity)	
5977	6K4
5992	6V6GT
(6V6GT filament current rating is 25% lower)	
5993	6X4
6005	6AQ5
6006	6SG7
6021	6BF7
(6BF7 is ⅛" longer and has lower transconductance)	
6028	6AK5
(20 volt heater version of 6AK5)	
6042	6SN7
6045	6J6
6046	25L6GT
6057	12AX7
6058	6AL5
(6058 is ⅜" longer and has 27% higher voltage ratings)	
6059	6BR7
6060	12AT7
(12AT7 interelectrode capacitance is higher)	
6061	6BW6
6063	6X4
6064	6AM6
6065	6BH6
(6065 has 33% greater heater current rating and half the Gm of 6BH6)	
6066	6AT6

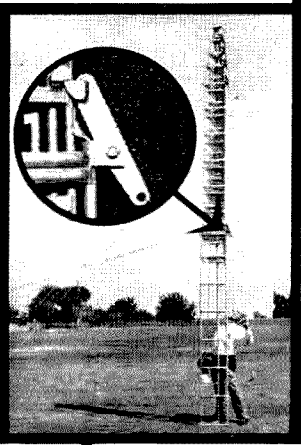
BUY THE FINEST TOWER MADE — BUY TRI-EX!
THERE IS A TRI-EX TOWER TO FIT YOUR ANTENNA REQUIREMENTS
tri-Ex
tri-Ex

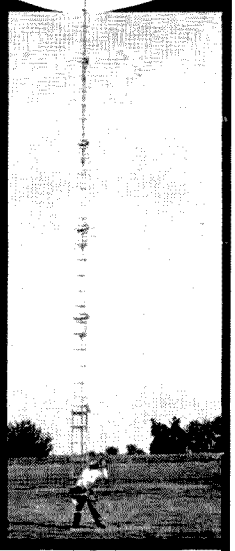
NOW! GUY SAFELY—FROM THE BOTTOM-UP!

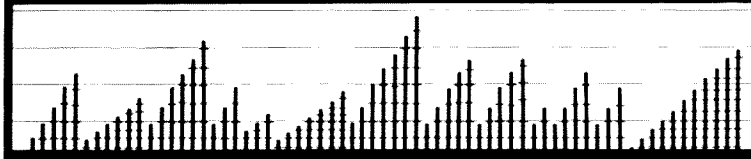
AND REMEMBER —
A GUYED TOWER WILL CARRY THE REALLY BIG ANTENNAS.

New you can avoid the hazard of raising — then guying an antenna tower. With TRI-EX guy-as-you-go towers, you guy-off one section at a time, from the bottom-up, as the tower is raised! Here is how it works: *First, all sections but the bottom section (which is guyed before you start) are raised nested together. The second section is then guyed off and the rest are raised nested, etc. until the tower is all the way up.*









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(Maximum rating of 6AT6 is 22% lower)
6067.....12AU7
6072.....12AY7
(12AY7 heater current is 14% lower and interelectrode capacitance is 6% lower)
6073.....OA2
6074.....OB2
6080.....6AS7G
6082.....6AS7G
(6082 is 26.5 volt heater version of 6AS7G)
6085.....12AU7
(6085 has 100% higher heater current, 80% higher transconductance and 77% higher amplification factor)
6087.....5Y3GT
6094.....6AQ5
6095.....6AQ5
6096.....6AK5
6097.....6AL5
6098.....6AR6
6099.....6J6
(6099 has balanced plate currents)
6100.....6C4
(6100 is ⅜" higher and has 25% higher interelectrode capacitance)
6101.....6J6
6106.....5Y3GT
6113.....6SL7GT
6118.....6Q7
6132.....6CH6
6134.....6AC7
6135.....6C4
(6135 has higher heater current)
6136.....6AU6
6137.....6SK7
6145.....7AD7
(7AD7 plate voltage rating is 100% higher and transconductance is 5% lower)
6169.....7F8
6180.....6SN7
6185.....2C51
6186.....6AG5
6187.....6AS6
6188.....6SU7
6189.....12AU7
6197.....6CL6
6201.....12AT7
(6201 amplification factor is 10% higher)
6202.....6X4
(6X4 has 40% higher output rating)
6215.....1B3GT
6265.....6BH6
(6BH6 heater current is 14% lower and plate resistance is 40% higher)
6268.....4C35
6277.....3B28
6279.....5C22
6288.....816
6336.....6AS7G
(6336 has 230% greater plate dissipation and 160% greater Gm)
6355.....6AF6
6384.....6AR6
6385.....2C51
6485.....6AH6
6626.....OA2
6627.....OB2
6660.....6BA6
(6660 is ¼" longer)
6661.....6BH6
6662.....6BJ6
6663.....6AL5
6667.....6CL6
6669.....6AQ5
6678.....6U8
6679.....12AT7
(6679 has 10% greater amplification factor)
6680.....12AU7
6681.....12AX7
6830.....OA2
6831.....OB2
6922.....6BQ7
6BK7
(Reliable substitute but not directly interchangeable)
7000.....6J7
7184.....6V6
7193.....2C22
7700.....6C6
7752.....6AS6
7755.....6AJ5
7758.....6AR6
8016.....1B3GT

. . . W4WKM

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At

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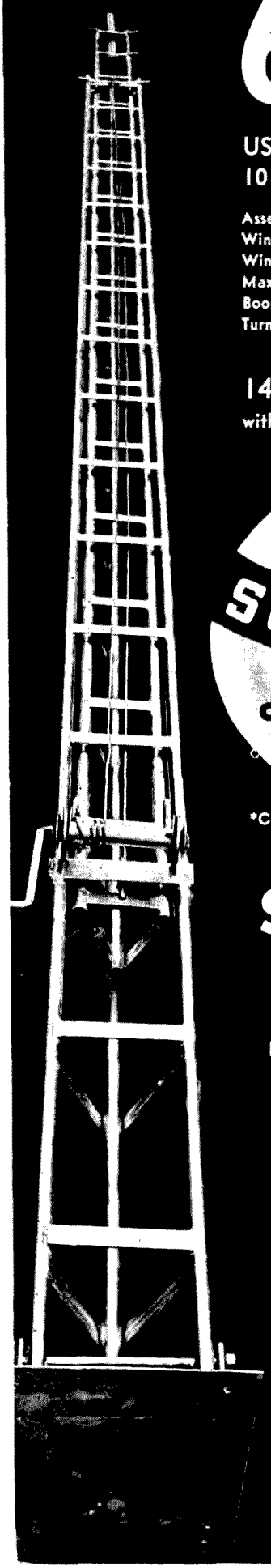
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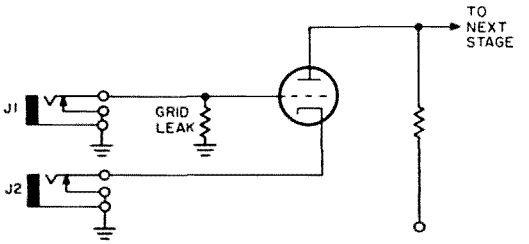
Mike Versatility

Would you like to be able to use either a carbon or a crystal mike in the same speech amplifier? This might come in very handy in equipment used in both mobile and fixed service. The secret of this versatile operation lies in the cathode follower configuration. For carbon mike service the control grid is grounded and the mike lies between cathode and ground. In crystal mike operation the cathode is grounded and the grind is operated in the standard manner.

There are several methods of accomplishing the switching required to bring about this small miracle, the simplest of which is shown in Fig. 1. This circuit employs two closed circuit phone jacks, one in the cathode and one in the grid. For operation, either a carbon mike is plugged in the cathode jack, or a crystal mike in the grid jack. This circuit is most useful in homebrew equipment where there is no shortage of panel space. Fig. 2 is slightly more sophisticated; here a single three circuit jack is used, with switching done in the plug. This circuit is of advantage where space is at a premium.

Both circuits have been used in assorted speech amplifiers with a great deal of success.

. . . WA2AKT



J1, J2 - NORMALLY CLOSED PHONE JACKS CIRCUIT

FIG. 1

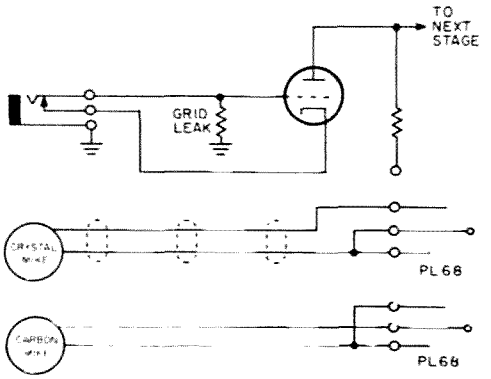
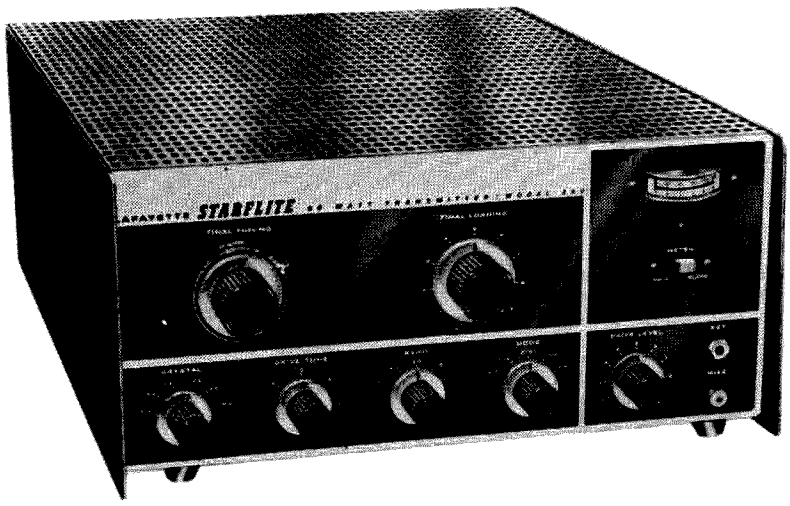


FIG. 2



73 Tests the Lafayette KT-390 Starflite

and likes it

Leonard Tamulonis WIMEL

EIGHTY DOLLARS, ninety watts, phone and CW. Those are the things that make the new Lafayette Starflite KT-390 transmitter a really desirable piece of gear for the ham-shack. While looking over the specifications, I wondered how Lafayette could get so much into such a small package for such a small price. Well, this transmitter comes as a kit, so *you* supply most of the labor, and cut most of the cost. The whole thing measures only 13 x 12 x 6¼ inches, and is very attractive in its two-tone steel cabinet. Size, cost, and performance make it even more attractive for the beginning ham who has to watch his cabbage.

There are 266 steps to final assembly, and since the instruction manual is liberally salted with diagrams, the job is foolproof (almost).

The circuit is simple enough for what it does. It consists of an oscillator that acts as a buffer stage with vfo operation, a driver, a modulator, and a 6146 final. A low-pass filter is built into the back of the cabinet, and the shielding of the entire rig is pretty thorough. This should help out the ham who lives in a forest of TV antennas (and who doesn't nowadays?).

A schematic of the Starflite is shown in Fig. 1. The 6CL6 (V1) functions as a modified Pierce oscillator with crystal control. When vfo operation is desired, the vfo is plugged into the appropriate jack, and the 6CL6 then functions as a buffer stage between vfo and driver.

The driver tube (V2, another 6CL6) operates as a class C amplifier. The plate circuit of this stage is tuned by the "DRIVE-TUNE" variable capacitor, and the coil L_3 (or sections of the coil that are selected by the band switch). The entire stage operates straight through on 80 and 40 meters, functions as a doubler on 20, a tripler on 15, and as a quadrupler on 10. The drive level control (pot R5) controls the screen voltage of the driver, and therefore controls the output that is fed to the grid of the final.

A 6146, complete with parasitic suppressor, is used in the final, and operates straight through on all bands as a shunt-fed, neutralized amplifier. The tank circuit is made up of C20 (the final tuning capacitor), L_6 (or sections of it that are selected by the band switch), and variable capacitor C22 (final loading). This final loading capacitor consists of three 450 mmfd capacitors in parallel, so that there is no need to switch fixed capacities in and out when band changing. A 69 mmfd disk ceramic was added to the tank coil to maintain a good L-C ratio on 80 meters. The whole thing is a pi network output, so any of the regular dipoles and antennas having 50 to 75 ohm impedance should work out well.

A metering switch is located just below the modern horizontal meter on the front panel. In the "GRID" position, the meter reads the voltage developed across a 620 ohm resistor in the final, and in effect measures the current passing through the resistor. In the "PLATE"

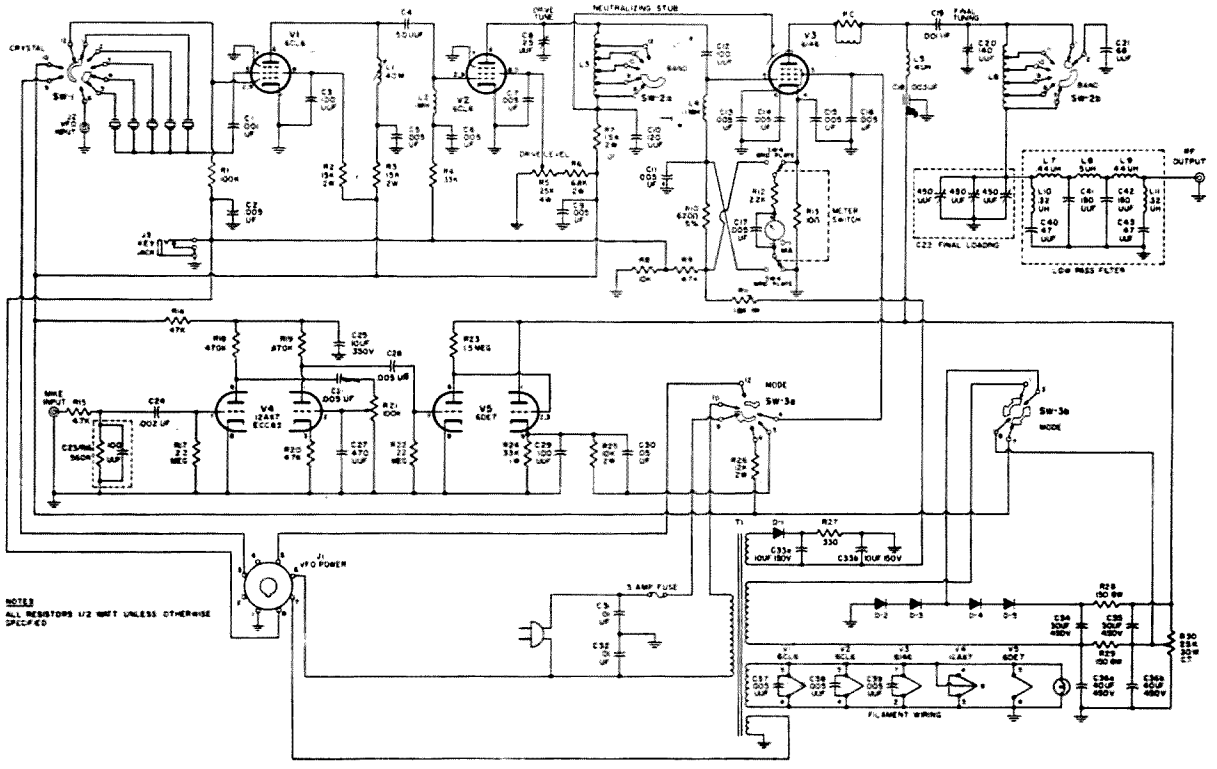
position, the meter reads voltage that's developed across R13 on the cathode of the 6146, and as before, the effect of measuring current is achieved. Although cathode current is actually a combination of grid, screen and plate current, the readings may be taken as actual plate current. The error caused by the addition of grid and screen current is very small, and on the legal side.

The Starflite uses carrier-controlled modulation, and judging by some on-the-air-reports that I've gotten, there seems to be a lot of misunderstanding about this sort of modulation in general. The 2 triode sections of a 12AX7 (V4) act as a regular resistance coupled audio amplifier. The output of the second triode section is coupled to the first half of the modulator tube through C28. The modulator tube is a 6DE7 (V5) that contains two dissimilar triodes, one with a power rating of 1.5 watts, and the other with a rating of 7 watts. The output of the low power triode is directly coupled to the grid of the higher powered triode which actually functions as the modulator. Bias voltage on the 6DE7 is arranged so that conduction is low when there's no audio input signal. This lowers the screen voltage of the 6146, and naturally when the screen voltage goes down, so does the plate voltage and output. An audio input signal that's caused when someone speaks into the mike reduces resistance in the modulator section, and raises the screen voltage of the final. Naturally, this jacks up your plate current and output, giving you carrier-controlled modulation.

Grid block keying is used in the Starflite, and a good thing too! This method of keying gives the least trouble as far as clicks and things like that go. Grid block keying in the Starflite is accomplished like this: with an open key, a high bias voltage is fed into the grids of tubes V1, V2, and V3. This high bias voltage cuts off these tubes and eliminates any output. In the key down position, R8 is shorted, and this cuts out the high bias to V1, and V2. It leaves a small amount of bias on the final (V3) to protect it in case the drive is suddenly removed. The values of R8 and C2 were chosen by the Lafayette people to give the most desirable CW waveform.

Lafayette is using a unique power supply for this transmitter in that it uses four silicon diodes in a voltage doubler circuit. These diodes are more efficient than their tube counterparts because they use no filament power, and voltage drop is much less. Filtering is accomplished through a capacitor input filter that is made up of R28, R29, and C34, 35, and 36. Of course there is an accessory socket that provides the necessary voltages for convenience in operating vfo, CW monitor, etc.

On the air tests proved this little transmitter to be extremely satisfactory (satisfactory



SCHEMATIC DIAGRAM

enough so that the writer had a short fist-light with the editor when the latter decreed that the Starflight had to be sent back to Lafayette after testing). Operation on 80, 40, 20, and 15 meters was good, but a little critical tuning on 10 was necessary to keep a good quality signal going out.

All in all, this rig turned out to be quite a surprise, and just a hair short of fantastic for the price tag. It makes a sweet rig for the Novice who will get his general class license and won't be able to afford a new rig. It makes a swell rig for the ham who'll want to keep it around as a standby rig, or who'll use it portable on Field Day or vacation.

. . . WIMEL

Complicating the Simplescope

Harvey Pierce WØOPA
5372 E. Bald Eagle Blvd.
White Bear Lake 10, Minnesota

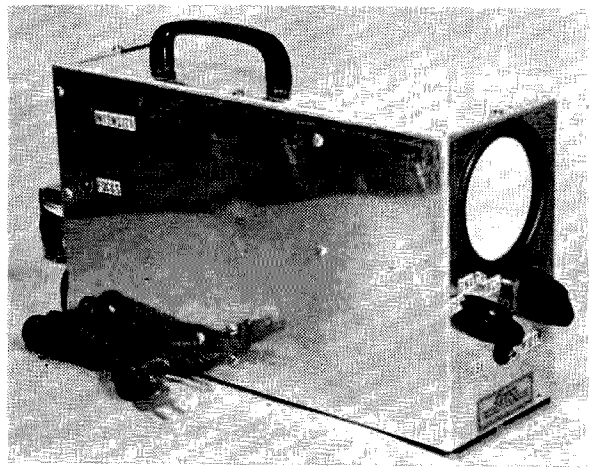
THE "Simplescope"* was conceived as the simplest form of an oscilloscope that would give adequate service as a phone monitor. But it was too simple for some ambitious builders who wanted to complicate it by adding various features they felt a scope should have. Of all the ideas for improvement, a few had merit. Here is how you can "Complicate the Simplescope" to get the "LARGE Economy Size."

The complications are the use of a 3-inch CRT, the use of the scope to monitor received signals, the addition of a pilot light, and spot centering. All were tested for simplicity and economy, and the Simplescope Mark II, shown in the pictures was built. The original circuit was merely added to, so those of you who built the original Simplescope can add one or more of these changes without too much trouble.

The 3-inch CRT change required some researching. Surplus catalogues and flyers were consulted, handbooks and spec sheets studied, and comparisons made. Nearly every big surplus house had 3BP1's for $1.95. Of the 3-inch CRT's available, the 3BP1 and the 3GP1 were the most suitable for the Simplescope, as they took the lowest voltages. The 3AP1 was ruled out only because it required a 2.5 volt heater supply.

A 3BP1 was purchased and work was begun. At first the original circuit was tried and the 3BP1 given a trial run. More than the 600 volts from the quadrupler was needed to get good focus and good brilliance, so a second power transformer with a voltage doubler circuit was added and connected in series. With about 900 volts pushing the electrons, the 3BP1 worked fine. Focus was good, brilliance good, and deflection sensitivity good. 'Scope design is a compromise between brilliance and sharp focus on one hand and deflection sensitivity on the other. This one is no exception. The 2AP1 and 3AP1 should have at least 500 volts, the 3BP1 and 3GP1 at least 850.

If the Simplescope is to be used to monitor the received signals, it must have a vertical amplifier with certain features. The amplifier should be broad-band, at least up to 500 kc, or even 2 mc, so it could be used with all common receiver *if's*, and have an output of at least 75 volts peak-to-peak. It should also have relatively high voltage gain. Reading the RCA Receiving Tube Manual revealed that the 6CL6 and its bigger brother the 6AG7



The "Large Economy Size" Simplescope. Handle is mounted toward the rear for proper balance. Note NE2 pilot light below knobs on front.

*See the Sept., 1961, 73 Magazine.

were both capable of 130 volts output in a broadband video amplifier up to 4 mc. The voltage gain was a shade over 40, so that a bit over 1 volt would be enough input for a good clear pattern on the 'scope.

Heater and plate ratings for these tubes were a trifle high for the additional power transformer added to the original Simplescope power supply circuit to build up the voltage to 900 volts for the 3BP1 CRT, but no trouble was experienced in using this transformer to supply the amplifier. The amplifier and added power supply circuit are shown in Fig. 1 added to the original Simplescope circuit of my previous article. Points of attachment are marked with an "X," and other added parts marked by a °.

Switching is now done by a 4-pole, 4-position switch to give an added position to turn on the amplifier and the high voltage for monitoring received signals. From long experience in using 'scopes, I felt there was no need for continuous receiver monitoring, so this provision was made for turning the amplifier off. The life of the CRT phosphor is extended this way, and the overload on the added transformer reduced.

Switching of the vertical deflection plate from the transmitter to the amplifier was avoided by coupling it to the "ANT" jack by a 22 mmfd mica capacitor. This value gives adequate coupling at 4 mc, yet a minimum of bypassing at a 455 kc *if* frequency from the amplifier. Switching would be better, but complicated, as the switch would have to be at the rear, otherwise the long leads to a front panel switch would bypass more rf than the 22 mmfd capacitor does. As an added bonus, this circuit will monitor *both* transmitted and received signals during a QSO without added relays or switching when the "USE" switch is in the "RCV" position.

The amplifier can be built as a separate unit if you wish, to use with an already constructed Simplescope. With its own power supply it can be permanently connected to your receiver and its output plugged into the rf jack of the Simplescope as needed. The original Simplescope circuit must be changed for use with this amplifier by the addition of a 15 K ½-watt resistor between the rf choke and ground at the rf jack. This will not change the original operation of the 'scope in any way.

The addition of a pilot proved easy and cheap. It can be added to any Simplescope. A rubber grommet, an NE2 neon bulb and a 180 K ¼-watt resistor are all the parts needed. The grommet should have a hole that fits the NE2 snugly, and is mounted on the front panel

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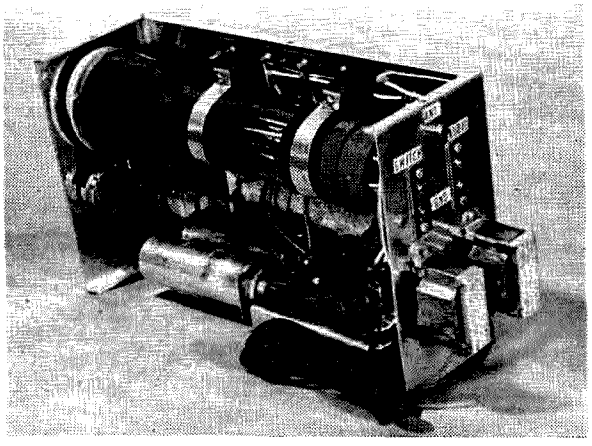
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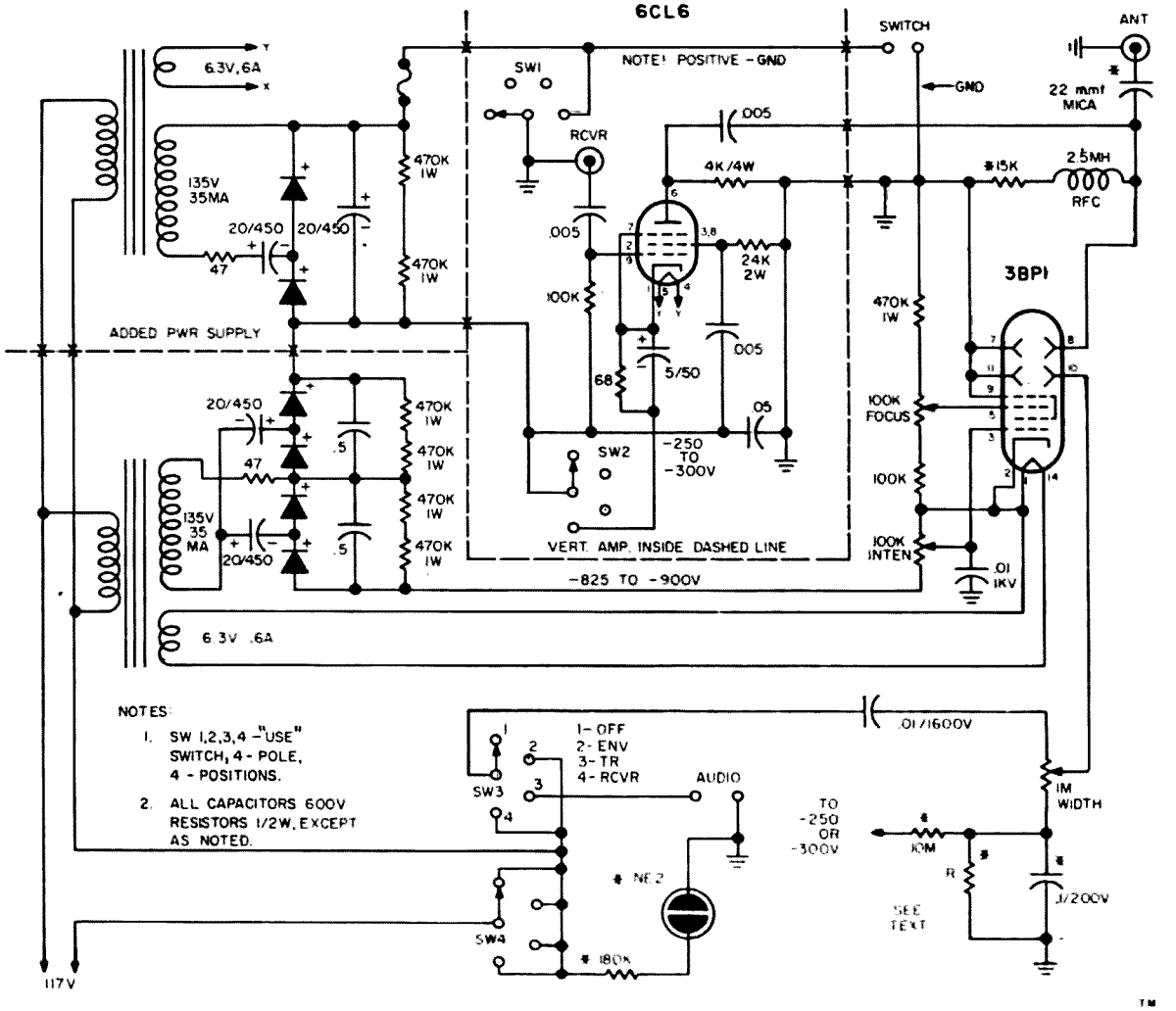


Rear terminals and transformer mounting. The "RCVR" phono jack is at center, bottom, hidden by the transformer, for short lead to the amplifier.

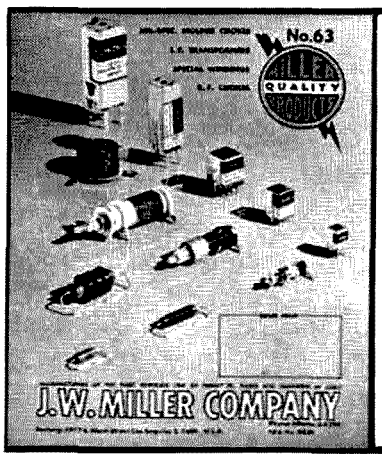
as convenient. The NE2 is pushed half way thru, wire leads inside. Ground one of the wires to the case. Connect one lead of the 180 K resistor to the lug of the "USE" switch that goes to the power transformer. The other resistor lead connects to the unused lead of the NE2. Use insulating sleeving to avoid shorts.

Connected this way, the neon light shows three things. If everything is hooked up right to the 'scope, it acts as a pilot light, indicating if the power is off or on. If the 'scope is not grounded it will not light at all, or very dimly. Lastly, if the ac cord is plugged in wrong it will light when the switch is off.

The spot centering problem seemed to be due to the magnetic field of the earth, and the spot was always left of center, no matter which way the tube was rotated. With the deflection plates connected in Fig. 1, and the locating guide slot of the socket on the bottom, two resistors and a bypass capacitor added to the circuit will pull the spot over near the center. The bottom or ground end of the width control is bypassed to ground by a .1 mfd capacitor, and connected to the −300 volt tap on the power supply thru a 10 megohm ½-watt resistor. Various resistors of up to 1½ megohms are tried in parallel with the .1 mfd capacitor until one is found that centers the spot, and then this resistor is



Corrections: eliminate connection to position one on SW4—change "X to Y" at transformer heater winding.



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soldered in place. This is much cheaper and simpler than putting in a control.

No vertical centering was attempted because the vertical position of the spot was not far enough from center to matter.

The pictures show the general construction of the "Large Economy Size Simplescope." The vertical amplifier is mounted on a 4 x 4 inch subchassis, and uses two 8.2 K 2-watt resistors in parallel to make up the required 3.9 K 4-watt plate resistor called for by RCA. Also, the screen resistor is two 47 K 1-watt resistors in parallel to get the 24 K 2-watt value required. Power transformers are mounted on the outside rear to prevent distortion of the spot by their ac magnetic field. Rf leads are as direct and short as possible, and away from the chassis to avoid losses. No other precautions (outside of the usual care in insulating high voltage leads) are necessary.

The Large Economy Size Simplescope was built in a Premier Minibox, 12 x 7 x 4 inch size, and cost me, (except for bolts, nuts, wire, handle, and knobs, which came from my junk box) just $13.85. Many items came from kits and only the Minibox was purchased at what might be called the standard price, and was the most expensive item, at $3.17. The two power transformers are $1.35 each (Cat. #T-173 from Olson Electronics). The silicon diodes costs 36¢ each (#T200, from TAB, New York). The three potentiometers used should be linear taper if you must be particular, but it really isn't too important. The rubber tubing used as a grommet around the CRT opening is a section of an old Stethescope tube donated by a doctor friend.

Installation of this version is the same as for the earlier Simplescope, except for a connection to your receiver. Enough rf from the transmitter is fed into the "ANT" jack to produce a satisfactory pattern and enough audio from the modulator is fed into the "AUDIO" connectors to give a good Trape-

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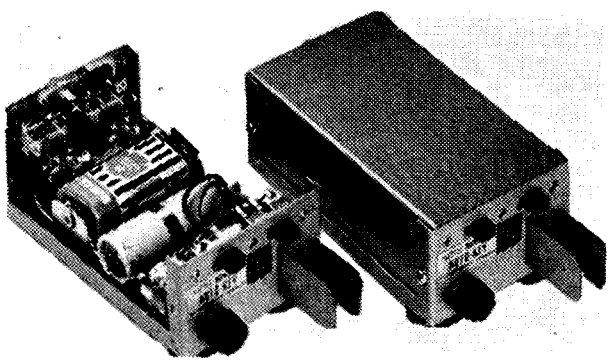
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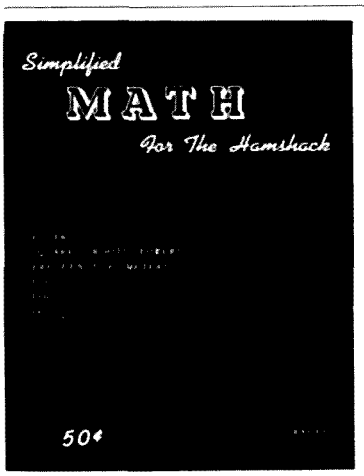
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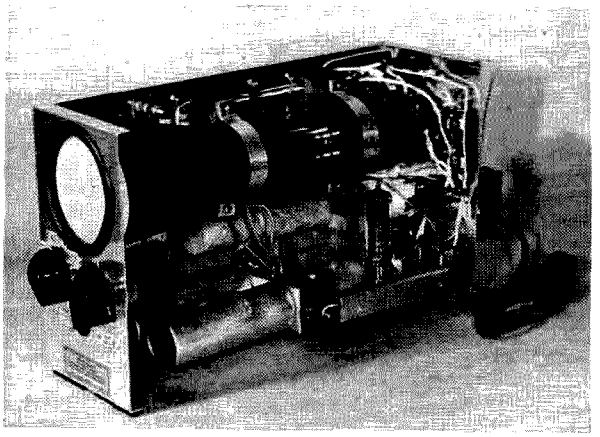
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Interior view, showing method of mounting the 3BP1. 'Saddles' are wood, straps of thin (.015") aluminum. Insulation board holds saddles, quadrupler supply, and "Focus" and "Brilliance" controls, is mounted 3/8" away from metal case.

zoid. The best method of getting rf from the transmitter is by coupling thru a small capacitor to the coax output connector. The size of this capacitor depends on several factors, and cannot be specified. Start at a couple of mmfd and increase as needed. If you have really wild SWR's on your antennas, it may have to be a variable.

The audio *must* come from the actual modulated voltage, regardless of the type of modulation used. It should be at least 25 v rms, or 80 v peak-to-peak for a good pattern. In AM rigs, add one, 1-megohm, 1-watt resistor in series (inside the transmitter) with the audio lead for every 250 volts of modulated voltage over 250 v. In some SSB and DSB rigs the available audio may be insufficient. If so, a hi-fi audio transformer may be tried to step up the voltage, but there is a possibility that phase shifts might distort the pattern.

Connecting to the receiver is more complicated. First locate the plate terminal of the last *if* amplifier (the one that feeds the detector) and the lead from it to the last *if* transformer. The connection is made to the transformer plate terminal if it has one, otherwise the tube socket plate terminal is used. The 'scope is coupled to this terminal thru a small capacitor. The size of this capacitor cannot be predicted precisely, but should not need to be over 75 mmfd to give a good pattern with an S9 signal. Start with a few mmfd and increase the value until you get a readable pattern from a moderately strong signal.

Use low-capacity shielded wire inside the receiver for this connection to prevent possible *if* feedback and oscillation. Keep all leads short, and *don't forget* there is *plate voltage* on that *if* tube! Every time the coupling capacitor is changed peak up *only* the input (plate) side of the detector *if* transformer for maximum pattern height on the 'scope, using a steady signal or a signal generator. The wire to the 'scope should have as little capacity to ground as possible. Be sure the 'scope is grounded to both transmitter and receiver.

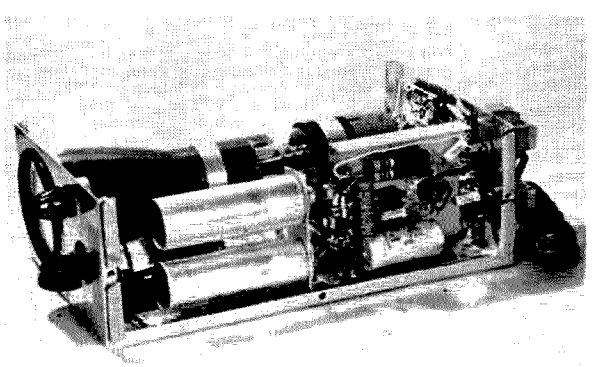
The 6CL6 amplifier needs about 2 volts of rf on its grid for the maximum, and ½ volt for the minimum, useable pattern.

Remember, the oscilloscope is very susceptible to stray magnetic fields, so for the cleanest patterns do not place it near any magnetic devices such as transformers, relays, clocks, motors, or even solder guns! For practical purposes all transformers should be at least 6 inches away, relays, clocks, and motors a foot or more.

The "SWITCH" terminals should be connected to switch or relay contacts that close when the transmitter goes on the air. While these terminals are shorted when the use switch is in the "RCV" position, spot switching is required in the other two positions to avoid "burning" the CRT phosphor.

There is little need for a vertical gain control. The weaker received signals have so much "grass" on them from QRN and QRM that more gain wouldn't help, and the strong signals can always be reduced by the receiver's rf/*if* gain control. The transmitter always puts out the same power and about the same rf voltage into any reasonably "flat" coax line.

With the "USE" switch turned to the "ENV" position, the 'scope is turned on, and shows the envelope type pattern on transmitting. The "TR" position gives a trapezoid pattern on AM when transmitting, or a bow-tie pattern on SSB. The "RCV" position turns on the vertical amplifier, and the 'scope shows



Underneath view, showing amplifier layout. Tie point strip (center) holds voltage-doubler supply connections and parts. Each electrolytic can contains two 20mfd 450 volt electrolytics, with separate positive and negative leads. Upper can is used for the doubler circuit.

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the envelope type pattern on both transmitted signal and the received signal, without further switching.

The first two positions are necessary to monitor your transmitted phone signals properly and monitoring by 'scope of received signals is not needed 95% of the time. Once you have checked a guy's modulation and told him about it, and perhaps checked again as he adjusted his gain, there's not much use in watching any more. So switch back to "TR" or "ENV" so you can keep your own modulation right up there and conserve the CRT phosphor while receiving.

The envelope pattern of the received signal is not always a true presentation of the transmitted signal due to the limitations of the receiver and the propagation path. The receiver bandwidth affects the apparent modulation of the higher frequency sidebands, and the truest pattern is shown with the greatest bandwidth. Yet even with an 8 kc bandwidth it could be possible for the signal to be overmodulated by a 10 kc parasitic the receiver wouldn't show! Fading on the lower frequencies is often selective enough to remove either carrier or sidebands, giving wide variations in apparent modulation. Such a signal must be watched for some time and averaged to get the approximate modulation percentage.

Despite these limitations, monitoring received signals by 'scope is a rewarding experience. Certain makes and models of transmitters can be identified by their patterns! Good, clean, well-modulated signals look as good as they sound. Surprisingly, over-modulation is NOT the prime cause of severe splatter! Broad signals are often apparently undermodulated, while the definitely overmodulated ones are often surprisingly narrow.

There are so many variations of power supplies possible for the high voltage that it would only be confusing to even list a few. You're welcome to try any and all varieties of rectifiers and multiplication circuits that you want. The one shown in Fig. 1 is OK and inexpensive, but is just one of many possibilities. What is needed is 900 volts at 2 ma, −250 volts at 40 ma, and two 6.3 heater windings at .6 amp or more each.

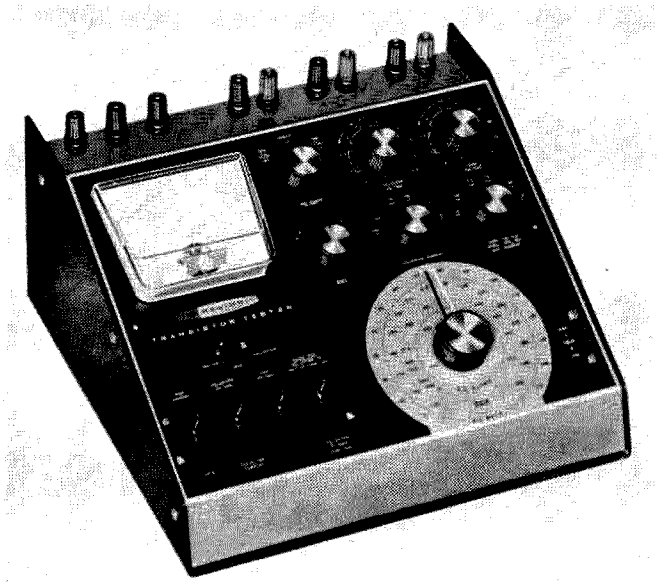
WARNING! Ordinary insulation does a pretty good job below 1,000 volts but is risky above that, so don't get any ideas about using 1,250 or 1,500 volts in these Simplescopes. It isn't worth the trouble. And don't get careless with the 800 to 900 volts in this 'scope! It bites real hard! Be sure all insulation is clean and unbroken.

The complications added to the original Simplescope circuit as described in this article

are about as far as it is advisable to go in an instrument of this type. Anything further would bring it into a class with kit and commercial type scopes. The 3-inch Simplescope with vertical amplifier does a very adequate job of monitoring at a very reasonable price, without complicated circuitry, requires no special parts, and should not prove to be a difficult building job.

I want to thank Dick St. Amant WøGZQ, for his thorough testing of the model shown at his station under typical conditions. I almost didn't get it back, he liked it so well! And again my thanks go to my friend Bob Rode WøBRE, for the excellent photographs.

. . . WøOPA



Capt. John Sury W5JSN
139 Nebraska Road
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The Heath IM-30 Transistor Checker

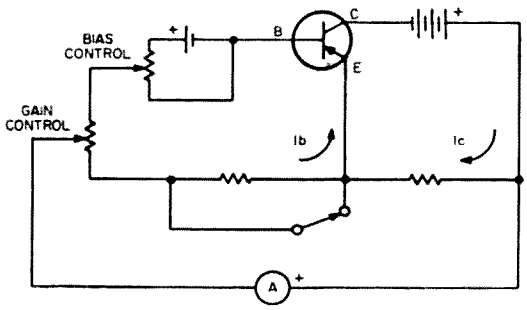
Here is a piece of test equipment that has been misnamed. Instead of a transistor tester it should have been named the transistor analyzer. This is exactly what it does. It measures 5½x10¾x10¾. The tester tests transistors and diodes under conditions that correspond to actual dc operating conditions. Since the author has specialized in transistors for the past 7 years this equipment is right up his alley.

The kit is complete and the instructions are thorough. Only precision components were used in this kit. It was constructed and tested by the author in approximately 20 working hours.

With transistors coming into the amateur field more each day this piece of test equipment fills the bill. It would almost be impossible to cover all the parameters this tester covers in this article.

Just about everyone who even has a slight interest in transistors wonders what the gain is of a particular transistor. This is a good way to find similar transistors when using 2 PNP in conventional push pull amplifiers or PNP and NPN in complementary symmetry amplifier for receivers or modulators.

Let's cover the gain test (dc beta-dc alpha). Readings are taken off af a calibrated direct gain dial after the 10-0-10 micro-amp 100K/volt meter has been nulled. The following is the gain circuit:



GAIN TEST (DC ALPHA) (DC BETA)

The following additional information may be obtained direct:

Base current (Ib)	Collector to base leakage (Icbo)
Collector voltage (Ec)	Leak voltage
Collector current (Ic)	Short test
Collector to emitter leakage (Iceo)	Diode Test

With some of the above information and an external voltmeter used in several instances the following information may be obtained:

AC current gain $\frac{Ic_1-Ic_2}{Ib_1-Ib_2}$	DC Transconductance $\frac{I_c}{E_b}$
AC Transconductance $\frac{Ic_1-Ic_2}{E_{b1}-E_{b2}}$	DC Base resistance $\frac{E_b}{I_b}$
AC Base resistance $\frac{E_{b1}-E_{b2}}{I_{b1}-I_{b2}}$	DC Collector resist. $\frac{E_c}{I_c}$
AC Collector resistance $\frac{E_{c1}-E_{c2}}{I_{c1}-I_{c2}}$	

What difference is used in the formulas two different bias or voltage points have to be taken.

The author selected a bargain basement transistor audio *if* type which costs less than a dollar and made several checks with some surprising results. It was a PNP with a gain of 90 which is excellent. A transistor has good gain if it has a gain of 70. The base *ac* resistance was 750 ohms and the collector *ac* resistance was 1500 ohms.

The base and collector resistances become important when a transistor is to be used in a circuit. This allows the builder to properly match the input and output. The checker in itself is an education in transistors. It takes a little practice and usage to master it. Remember it is a piece of laboratory test equipment. Instructions with the tester are very clear to follow. . . . W5JSN

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Simple Squelch

David Bernays K4UWX
HAMBOARDS
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THERE is one basic circuit missing from most receivers currently available to the modern amateur—squelch control. Essential for VHF operation, squelch can also provide a tremendous increase in operator enjoyment on the lower bands or wherever QRM and background noise levels are high. The lack of such a circuit becomes extremely obvious whenever one of our present communication receivers is used as a tunable *if* for VHF converters. Fortunately the problem is easily solved, as a squelch circuit may be incorporated in most receivers with minimum effort and without disfiguring the equipment. A simple, proven circuit for this purpose is outlined below.

First, however, for those who have never used a receiver with squelch, it will be worth while to back up and define exactly what this circuit does. Stated simply, the squelch circuit is an active circuit which effectively silences the receiver in the absence of signals stronger than a certain preset threshold. The word active should be noted, for it is what separates a true squelch circuit from judicious adjustment of the various receiver gain controls. Squelch circuits are normally tied, either directly or indirectly, to the receiver AVC bus and obtain their controlling voltage therefrom. Squelch circuit operation is based on the fact that most noise and QRM, while of high audio content, actually represent little signal strength and therefore cannot develop significant AVC voltages.

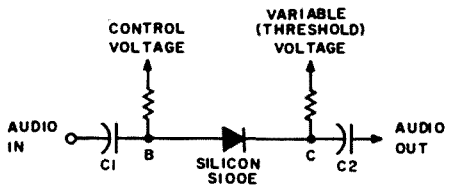


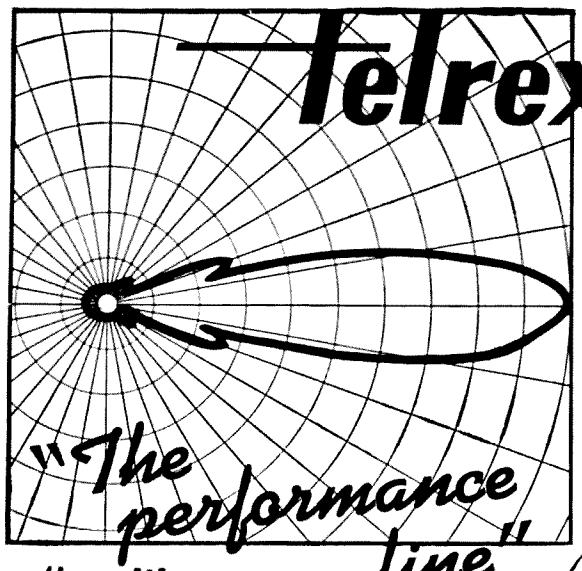
FIG 1

There are three basic requirements that must be met by any squelch circuit before it can be considered acceptable for inclusion in a typical communications receiver. These are:

1) The circuit may be installed without making any mechanical alterations to the receiver.
2) The squelch threshold must be a front panel control.
3) The squelch must operate reliably on the weakest signal that may be discerned above the background noise level.

The requirements of item one are obvious as most of us are unwilling to compromise the resale value of an expensive receiver. Thanks to TV (there must be something good about TV!) requirement two is easily satisfied. Squelch threshold can be made a front panel control by substituting a dual potentiometer with concentric shafts for the original receiver audio gain control. One section remains a volume control, the other is used for squelch threshold. These dual pots mount in the same size hole as the original volume control and are readily available from any parts house. The last requirement is operational in nature and based on a rather fundamental premise—none of us like to miss the weak ones as this is where the DX usually hides!

A simple circuit which fulfills the above requirements is shown in basic form in Fig. 1. Its operation is based upon the unique characteristics of a silicon diode. Such a diode, when forward biased, represents a very low impedance. When back biased the same diode has an effective impedance of ten or more megohms. Germanium diodes, because of their low back resistance, will not work. The best silicon diodes available are the high back resistance types. The Hughes 1N457 used here is typical (and also inexpensive). When it is con-



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nected as shown in Fig. 1, squelch action is obtained in the following manner. The variable voltage lead is connected to a potentiometer which allows this voltage to be set as desired. This is the squelch threshold control. The other side of the diode is connected to what will be called the control voltage and must be one which varies depending on the strength of the signal being received. Audio is applied to the circuit through dc blocking capacitors C1 and C2. As can now be seen, in the absence of signal it is possible to set the variable voltage (threshold) to where the diode is just slightly back biased, blocking the audio. Any increase in the control voltage will cause the diode to conduct. The diode then represents a very low impedance and allows the audio to pass. The control and variable voltages are both applied through isolating resistors whose combined parallel resistance must be greater than ten times the typical audio impedance of the circuit wherein the diode is placed in order to avoid bypassing a significant portion of the audio voltage.

The first source to be considered for a control voltage is the AVC bus itself. Unfortunately this bus normally operates at an extremely high dc impedance and will not tolerate the degree of loading the squelch circuit would impose upon it. A much better point to obtain the control voltage is the series fed screen grid on the last AVC controlled *if* amplifier. This screen grid's current (and therefore voltage) varies in accordance with variations of the dc bias applied to the control grid of the tube. As the control grid obtains its dc bias from the AVC bus it can be seen that the screen grid voltage will shift significantly for even the smallest of AVC bus fluctuations. The screen grid therefore provides an excellent source of control voltage, one that has both convenient magnitude and low dc impedance.

There are some cases, such as in the ARC-5 series of surplus receivers, where all the screens are fed from a common stiff medium voltage source. If this is the case on your receiver, the particular screen grid should be disconnected from the common line and the circuit shown in Fig. 2 substituted. The screen dropping resistor is chosen to provide the same screen voltage as was originally present. The value of 100 K shown on the diagram is typical and may be considered a good starting point to experiment from. The screen grid dropping resistor can also be optimized to provide the greatest voltage swing for small changes in the AVC bus voltage. This value is best determined by trial and error. So long as the screen grid voltage that results remains within 20% of the original value operation of

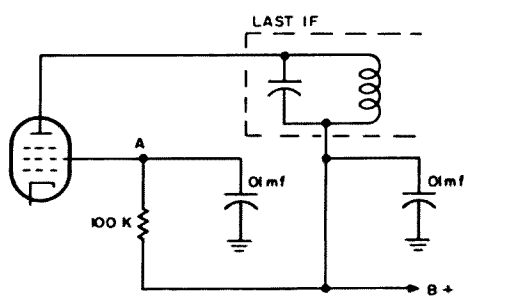


FIG 2

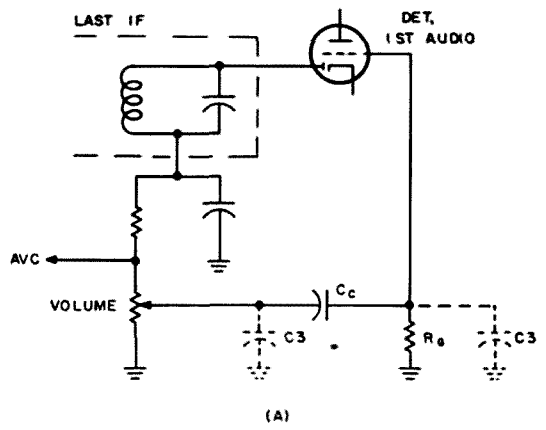


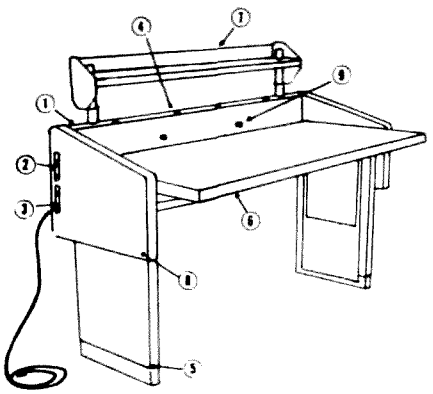
FIG 3

the last *if* stage will not be materially altered.

The best point in a typical communications receiver to apply this squelch is between the audio gain control and grid of the first audio amplifier. This stage, in its typical form, is shown in Fig. 3A. Fig. 3B shows a practical installation of the squelch circuit. Coupling capacitors C1 and C2 have been chosen so as to represent, in series, the same impedance as the original coupling capacitor. Resistor R2 has been split into three components so that the actual squelch threshold may be spread over a larger portion of the pot's rotation. R2B should be chosen so that it can swing the variable voltage over a greater range than will be present under any conditions at point A on Fig. 2. R2A through C can all be part of the same potentiometer, but this is not recommended. For the circuit to work in a positive manner, resistors R1 and R2A-C should be made the lowest possible values consistent with satisfactory performance. Their combined minimum value may be determined in the following manner. Before the squelch is installed, bypass the centertap of the volume control to ground through various resistors. (During this test the volume should be set at a comfortable listening level.) The smallest resistor which can be so inserted without degrading either the audio volume or quality will constitute the minimum ac resistance that the squelch circuit should be allowed to represent between the audio grid and ground. Examination of Fig. 3B will show that in the squelch circuit the equivalent to this resistance is actually composed of three separate parallel components. (For purposes of calculation consider the squelch to be at the high voltage end of R2B.) These are R1, R2A, and the total of R2B and R2C. The three resistances should be essentially equal in value. Their total parallel resistance should approximate the minimum value determined above. The values shown in Fig. 3B may be considered typical.

Capacitor 3C has been neglected so far in order to avoid confusing the basic fundamentals. It may be present in original equipment at either of the locations shown in Fig. 3A. When so placed its presence serves either or both of two purposes. The first is to remove any trace of *if* frequency components from the audio. The second is to provide a degree of tone control. C3 serves both of these functions in the squelch circuit plus one more. When the diode is back biased, there is still a very small amount of audio leakage. If this

ALL THAT NICE NEW EQUIPMENT ON THAT DIRTY OLD TABLE!
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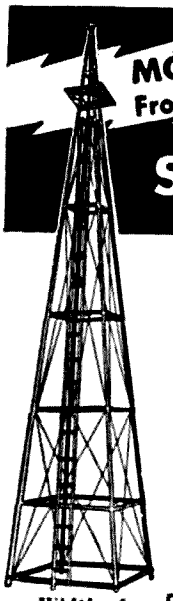
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is allowed to go directly to the first audio amplifier grid an audible output will be present at the receiver speaker. Placing C3 as shown in Fig. 3B shunts this small audio component to ground, allowing the squelch to achieve 100% quieting. The optimum value of 3C is best determined experimentally by substitution. The larger the value of 3C the better, the limiting factor being how much capacity can be inserted before the receiver's high frequency audio response is reduced to an unacceptable point. Some attenuation of highs will normally be beneficial in communications work, as will be noticed when experimenting with 3C. Typical values are 820 or 1000 mmfd.

A brief examination of the impedances involved in the complete squelch circuit is now possible and will help to explain the operation of the circuit. When the squelch is closed (diode conducting) the diode represents an impedance of several thousand ohms. Since the audio impedance of the circuit between the volume control and first audio amplifier grid is typically 100 K–500 K, the additional series resistance of the conducting diode reduces the available audio voltage only a few percent, an effect that is not noticeable. The combined shunt impedances of R1 and R2A-C decrease the available audio 1-3 db, depending on the values chosen. This is not a serious loss either as most receivers can provide considerably more audio than is ever needed. The impedance of 3C is also parallel to these resistors but varies according to frequency. (If it is chosen as outlined above, its presence, rather than detracting from, will probably enhance the audio characteristics of the receiver.) When the squelch is open (diode non-conducting) the diode represents a minimum impedance of 10 to 100 megohms. It, together with C3, may be considered an ac voltage divider. As C3 now represents a relatively low impedance (approximately 100 K at audio frequencies) compared to the non-conducting diode, it can be seen that negligible audio voltage will be present at their junction, or therefore at the first audio amplifier grid. This effectively silences the receiver.

Physical installation is extremely simple. The original volume control is replaced with a dual potentiometer, one section of which has the value of the original audio gain control, and the other section that of R2B. Most of the additional components may be mounted between the volume and squelch control terminals. An additional multilug terminal strip can usually be mounted somewhere near the volume control to provide convenient tie points

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- Model M-4 Mobile 6, 10, 15, 20 M. Net $16.95

Patents pending

Mini-Products, Inc.

for the remainder of the circuit. Long leads should be avoided if they are part of the first audio amplifier grid circuit. Where this is not possible, such leads should be shielded to avoid hum pickup.

This circuit has been installed in several receivers by the author, providing satisfactory results in all cases. The actual performance of this squelch appears to be more effective and reliable than many of the circuits commonly used in commercial communications equipment. It is certainly simpler! Effective squelch action, from fully silenced to fully open, is consistently obtained from signals 3-6 db above the background noise level. This corresponds to AVC bus variations of less than .05 volts. The advantages of adding such a squelch circuit are many and worthwhile. Once you have used a receiver so equipped, you too will probably consider squelch an essential control. . . . K4UWX

Good old Charlie Queen



Ralph Morris WIQUE

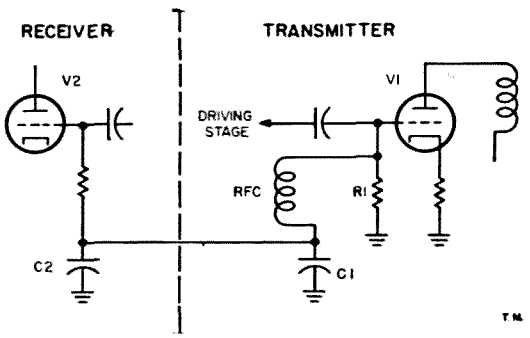
The other night when all the shows in Tennessee Valley had the odor of our local Clark's Cove mud flats at low tide, I placed a pair of cans on my dit happy head. After shooting the 60 cycles to my cabinet of used tubes, my hearing aid came to life. It was then that I heard a Space Jockey calling a Charlie Queen. Not being the type of fellow that drinks and shoots electrons into space at the same time, I put my glass of milk back into the ice-box and slapped the AC to the 55½ pounds of #12 that I got from an old battery charger. As soon as my 1A2's got red on the plates, the neighbors buzzed my land line and I knew for sure that I was on the air. As the XYL answered the twisted pair, giving the names of our local TVI committee to the Video Ranger that called, I gave the Space Jockey calling Charlie Queen a long shout. My signal must have punched a large hole in the QRM, because this Space Jockey started to pump my call letter down the coax and into my hearing aid. At once I knew that I had snagged a DX station. This RF Jockey lives a good five city blocks away from my QTH! He at once thanked me for shouting at him and gave me 10 Dog Biscuits. This made Duke, the canine member of our little family very happy. He also reads the mail. My contact then told me that he had his rig mounted on a bread board. Knowing that most bread comes already sliced, there must be plenty of these boards on the surplus market. He did however put a good signal into my bucket of tubes, in fact enough to make my cans rattle. At this point I switched to my Pretty Mary Squacker, and gave this Space Jockey an RST report of 5 square. I could not give him a true reading from my S meter, as it is one that I picked up at a surplus store and only reads "The Flow Of Fuel Per Hour." He told me that he could not have a long winded Rag Chew at this time as his favorite gun-slinger would soon appear on the one-eyed monster. He thanked me for the shout and the QSO which he said was Real Arm Chair Copy all the way. He asked me to send him some wall-paper for his shack. I told him that I would send his wall-paper by the next Pony Express. I thanked him for the chew as I sent him 73. Then I slung it back at him to tie the ribbons on it saying that I would see him down the log. After that I pulled the Main and slapped his name along with his XYL's handle on the log. I must finish this now, for some Joaker in a white coat is standing in back of me with a big net,——"Must be a TVI Complaint!"

Transceiving

Dean Cupp W4JKL

DID you ever build a transceiver and end up with a switching circuit using so many contacts you didn't know what to do? Relays and switches with many contacts are expensive and are more subject to failure. If you share this common problem Fig. 1 may be for you.

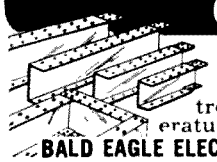
V1 is an ordinary class C power amplifier, V2 is the controlled stage. When the power amplifier is operating a negative voltage is developed across R1, the grid bias resistor. Since this negative voltage is only present during transmit it may be applied to the control grids of one or more stages of the receiver driving the tube(s) to "cut off." In this condition no (or very little) plate current is drawn and no signal is passed. AVC acts the same way with a very strong signal.



RFC, C1, and C2 are to prevent robbing V1 of drive or interfering with the operation of the controlled stage, and should be values appropriate to the frequencies used. (C2 will probably be larger than C1.) C1 and C2 are in parallel, as the lead could pick up a signal causing interference to the circuit at the end un-bypassed. Check to see that you have enough negative voltage across R1, or in the case of a higher powered transmitter, R1 could be made a voltage divider. It is recommended that the mixer and audio stages be controlled. Happy soldering and 73.

. . . W4JKL

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Spotting Simplified

George Thurston W4MLE
3407 Prock Drive
Tallahassee, Florida

THE Heath Apache and other transmitters are equipped with shiny bright red "spotting" buttons which, according to the manufacturers, are supposed to let you find your own signal in the receiver without putting a signal on the air.

But in practice, it often takes two left hands or an assistant operator to do the job in less time than it takes to tune up the rig on a new band.

These "spotting buttons" generally do nothing but turn on the VFO (and all subsequent stages) without actuating the antenna change-over relay or receiver muting device.

In phone operation this is usually OK, except that the signal is often so strong you can't zero a weak signal accurately because you just can't hear the beat note.

CW operation goes something like this:

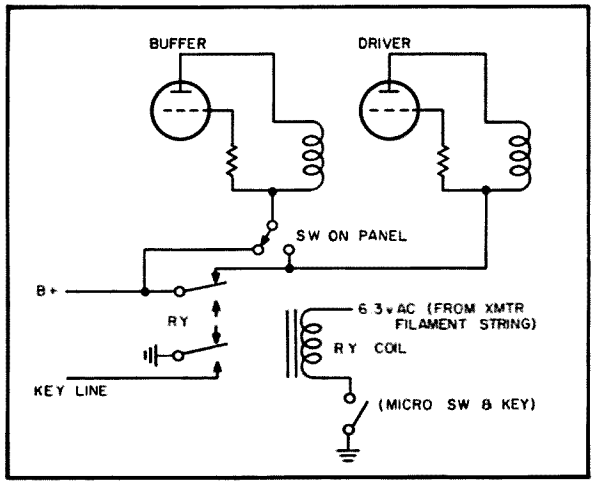
(1) You find an S-5 DX signal down the band calling CQ

(2) Turn off B-plus to the final

(3) Hold the "spotting button" down with one left hand

(4) Turn the VFO knob with the other left hand

(5) Reduce the receiver RF gain with the right hand to avoid arcing between your ear drums as the "spotting" signal screeches into place.



(6) Restore B-plus to the final and restore Rx gain to normal.

Failure to kill B-plus, of course, defeats the purpose of the spotting switch. Since the switch in effect simply closes the key, you'd put a carrier on the air if the final B-plus stayed on.

The solution—in the Apache, DX-100, or almost any other transmitter of whatever make—is a simple DPDT relay with a 6.3v AC coil.

The relay is connected so that one pair of contacts will close the key line when the relay pulls in.

The other pair of contacts disconnects the plate voltage from the buffer and/or driver stages following the VFO. This automatically keeps the spotting signal off the air.

The former "spotting" button on the front panel may now be used to close the circuit to the relay coil. A still better system, however, is the one I've installed in my Apache.

The switch lead for the relay coil is brought out through the accessory plug and connected to a micro-switch mounted next to the key. Thus, simply by moving my forefinger from key to switch toggle, I can actuate the relay, leaving my (only) left hand free to twist the VFO knob.

With only the driver stage disabled by the relay, I found the spotting signal still too strong for comfortable CW work. So I rigged it to cut off plate voltage to both the buffer and driver. This worked fine for CW but gave too weak a signal to use on strong phone signals.

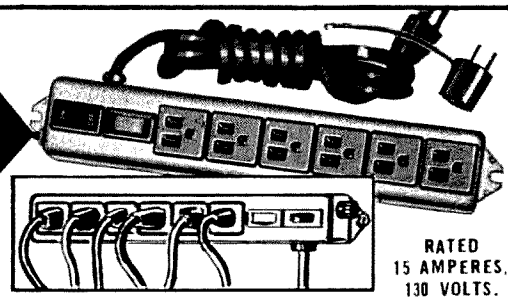
The solution was a two-position rotary switch mounted on the front panel in the place formerly used by the "spotting" pushbutton. In one position, this switch causes the relay to kill only the driver. In the other position, the relay kills both the driver and buffer.

Spotting with this arrangement is absurdly simple.

(1) Hit the spotting switch at the key

(2) Twist the VFO knob

(3) Release the spring-return spotting switch.

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Coax vs Open Line

Bill Roberts W9HOV
Gain, Inc.

Sometimes progress does more harm than good. World War II brought us the coax cable. Almost every amateur has used it in or around the shack. Up to the point when cable became available for amateur use, everyone used a variation of open wire feed.

We feel that we should make a box score on this old feed style and let you decide which is best. Score it honestly and let the chips fall where they may:

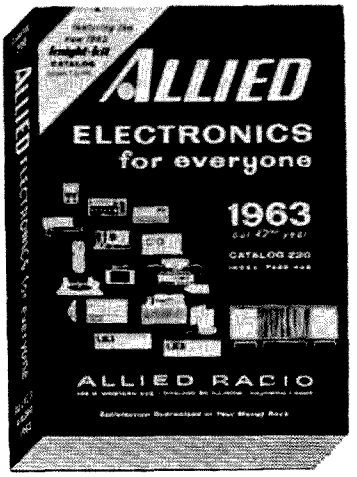
Weight	*Open Wire Light*	*Coax Heavy*
Losses mount heavily with High SWR	No	Yes
Will excessive losses render Line Inoperable	No	Yes
Will insulation burn through	No	Yes
Losses at 220 mc (100 feet) Pwr pct.	6 per cent	80 per cent
(using 144 mc	4.8 per cent	70 per cent
RG58U as 50 mc	2 per cent	46 per cent
com.) 14 mc	1 per cent	14 per cent
Cost	Cheap	Expensive
Deterioration with age	Negligable	Noticeable
Capitance in mmfd	O (virtually)	28. 5
When used as untuned line	Good	Questionable
Precautions for water on the line	None	Must be sealed
Effected by nearby objects	Some	Very Little

Now that I have given the pros and cons, it would seem that the score is 10 to 1 in favor of open line.

Let's assume we have a 2 meter antenna 100 feet in the air. Using coax all the way could result in the loss of 70 per cent of the power. Using open wire cuts this to a 4.8 per cent loss (1/14). After reaching the shack it should be converted (balun) to coax. This takes a little matching but maybe the saving of 65 odd percentage points of power makes it well worth the "trouble?."

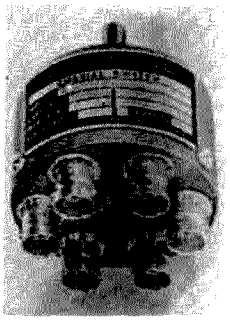
We are not asking you to go to open line, we are just asking if you can afford not to.

New, New



The Biggest

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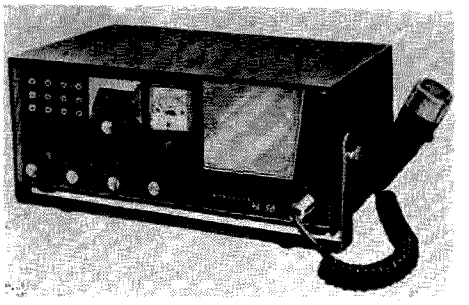


Coax Switch

Bay Roy Electronics, well known for their coax relays, now has a cute little DPDT coax switch which will work at frequencies up to 3000 mc. The switch will handle 100 watts and has BNC connectors. Drop a line to Bay Roy for prices. 16608 Madison Avenue, Cleveland 7 Ohio.

HE-45

HE-50

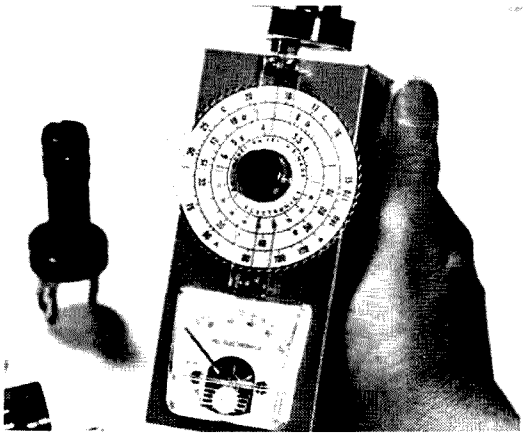


Lafayette Radio is coming out with new ham gear so fast that it is difficult to keep up with them. Their newest releases are a pair of six and ten meter transceivers. The HE-50 is the ten meter model, runs twelve watts to a 2E26 final and uses the popular 7 mc crystals. The built-in dual 117 vac/ 12 vdc power supply allows the unit to be used either at home or in the car without changes or separate power supplies. Comes complete with push-to-talk mike for $109.50, all set to go. The HE-45 six meter model is similar, using the 8 mc crystals and sells for the same remarkable price. The receivers are superhets with a 1650 kc *if* and an rf stage for good sensitivity and rejection of images. Both are 15 pounds, great for portability. Write Lafayette, 111 Jericho, Syossett, N. Y. or just buy one from this writeup or their ad on page 3.

Heath Catalog

The Heath Company is getting out a larger and larger catalog every year. Now it's beginning to look more the size of a Sears catalog. If you can read the latest catalog without eating your heart out for all that ham gear then you're suffering from a lack of imagination. Boy, if I had money could I tear into an order blank! Heath has more ham gear than any other classification, too! Write to Heath for their new 100 page catalog. Benton Harbor, Michigan.

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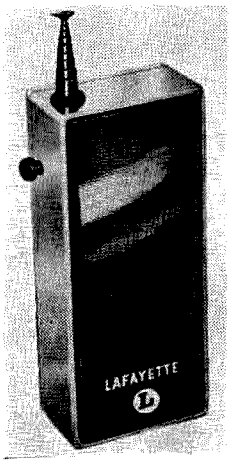
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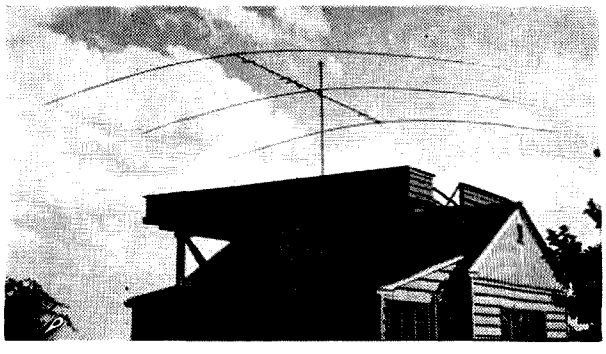
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CB Walkie-Talkie

While we don't ordinarily pay much attention to the new CB gear that is announced, this one looks worth a mention. Lafayette's HE-66L CB Walkie-Talkie sells for $19.95 each and uses crystal control for both receive and transmit, plus a superhet circuit in the receiver! Four transistors and a diode are used. Complete with leather carrying case, antenna, crystals and batteries. 85 mw power so you don't even have to have a CB license to use it. A pair of these ($38.95) are mighty handy around any ham shack. Lafayette Radio, Syosset, L. I., N. Y.



Bigger Than a House

The Telrex full size 40 meter beam, complete with 46' boom! Price? $725.00 without the cottage.

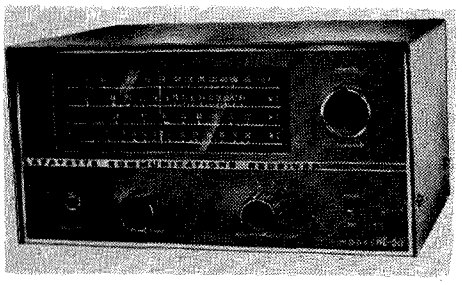
Books

Radio Frequency Systems is the first volume of the **Modern Communications Course** written by Mr. Edward M. Noll, W3FQJ, and published by Howard W. Sams and Co., Inc., of Indianapolis, Indiana. It is designed to fit with others in the course to give a practical and comprehensive coverage of radio communcations. The reader is assumed to have a basic understanding of radio receiver

operation and some fundamental knowledge of electronics. However, basic theory and modern design concepts are included in each volume.

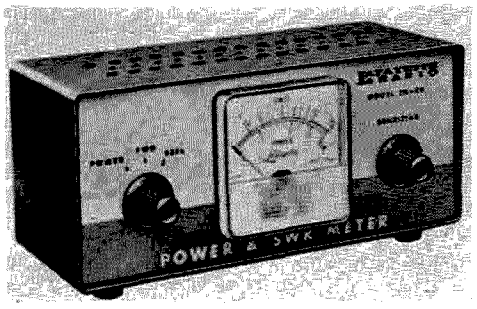
Radio Frequency Systems contain comprehensive coverage of Radio Fundamentals, Class C Amplifiers, Oscillators, Exciters and Frequency Multipliers, Power Amplifiers, Antennas and Lines, Antenna Matching and Tuning Systems, and Transistor R.F. Circuits. Although the course is primarily intended for use as a classroom text, the style of writing is so explicit that it is readily usable for home study. This should prove a worthwhile addition to your library. Price: $4.95. H.P.

Having Fun With Transistors is another Howard W. Sams Photofact publication by Ken Buckwalter. If you have any old oatmeal boxes laying around, this is the book for you. There are thirteen simple transistor circuits that you can amaze and mystify your friends with. Sample chapters: Home Broadcaster, The Speaker Mike, "Boris" the Talking Skull, and the Musical Oatmeal Box. Aside from a brief chapter on construction hints, there is nothing specifically for the ham. L.T.



General Coverage Receiver

The Lafayette HE-60 covers from 550 kc to 30 mc in four bands and is priced at only $39.95. Three tubes plus diode for five tube performance. Built-in speaker. Superhet circuit, bfo, etc.



SWR Bridge

Lafayette has come out with a power meter and SWR Bridge. This is designed for CB use primarily, but is quite useful for ham applications up to 50 mc and up to 15 watts, which covers a lot of territory. The SWR function will handle up to 1 kw, but the power meter is limited by the 15 watt dummy load built in. Model TM-58 ($27.95). Lafayette Radio, Syosset, L. I., N. Y.

The Inverted Vee-Beam

Paddy Labato W8DLU

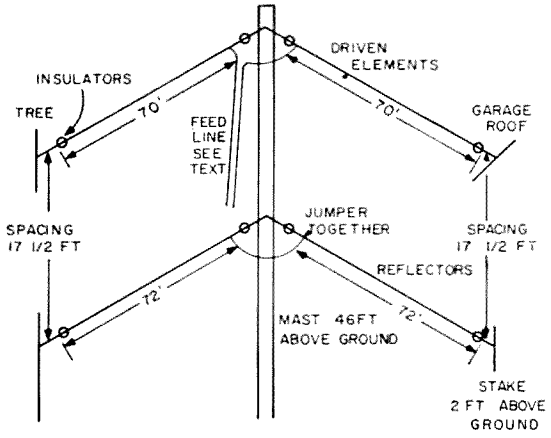
YOURS Truly—may or may not have been the inventor of the Inverted Vee antenna, however in 1926 I discovered that by slanting two wires earth-ward I began getting better reports from my one tube CW transmitter than with a horizontal Vee and long wire antenna that I previously had been using.

Through the years since that time I have tried every conceivable type of antenna from the bed spring to the super rhombic, etc., but for all-around performance, simplicity of construction, ease of feeding and pruning I give the Inverted Vee top honors.

During the past year I have been using a modified form of the vee which I call The Inverted Vee-Beam. And I have found results most gratifying. From W8DLU running 150 to 250 watts I have proof of WAC with QSL's from most all of Europe, S. Africa, S. America, Pacific Islands and Japan, all on 80 meter CW, and Europe, S. America and Pacific on 75 meter AM fone.

As many readers know, the Vee can be hung from house top, tree, window ledge, borrowed utility pole etc. I have selected to use a 25 foot mast above the house top with pulley hung thereto for raising or lowering antenna at will. The reflectors as shown here may or may not be used but I have found that besides providing extra gain they also serve as extra guy wires.

Due to slight rise in resonant frequency when slanting wires toward ground, the Inverted Vee will require slightly longer legs than the standard dipole requirements. Coax cable of most any type may be used for feeding if builder intends to work within 50 to 100 kilocycles of desired portion of given band. However, for covering an entire band such as 80, 75 and 40 meters with one antenna, it is suggested that open wire feeders with a suitable antenna coupler be used. In making checks with other hams in this area I have found that 300 ohm TV twin lead and/or the com-



mon 1 inch spaced open wire line that is used in some TV installations also make suitable feeders for the Inverted Vee. The coupler used at W8DLU is on the order of one described in March 1959 QST (McCOY). If open wire or twin lead is used it is desirable to cut feeders ¼ or ½ wavelength long. However if slightly shorter or longer line is necessary the antenna coupler will tune out enough reactance for desirable operation. Coax feedline may be of any length.

Dimensions as shown here are for 80 meter antenna and may be cut in half for a 40 meter antenna and so on for 20 meters. However keep feed point as high as possible. You will note through checking with grid dipper or SWR bridge that these measurements may not hold true for you. This is due to ground conductivity, surrounding objects, etc. The simplest way is to add or cut antenna length for the lowest SWR reading.

Some readers may ask, how can reflectors directly beneath the antenna act as reflectors? Will they reflect skyward or what? As far as I can determine, the Inverted Vee is a semi vertical-semi horizontal antenna. While making field strength checks we have found strongest lobes off the upper portions of the antenna and those lobes increased further along the antenna legs with the use of reflectors. Signal reports especially from DX were stronger when reflectors were used. ... W8DLU

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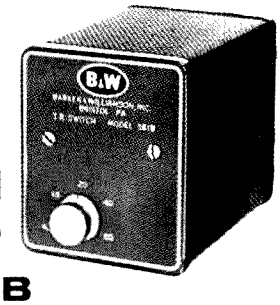
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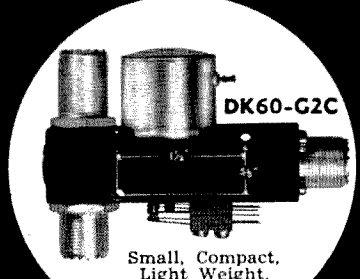
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IT is customary and traditional in electrical and electronic work to evaluate large inductances by use of an impedance bridge, an instrument so costly that few amateurs and experimenters can afford it. Impedance bridges range in price from a kit (Heath IB-2A), costing $69.95 plus several evenings of work, to beautiful laboratory instruments costing about as much as a new car. Unless the bridge is to be used many times a day, or in work where precision is of great importance, its purchase is not usually justified.

More than a decade ago, when the grid-dip oscillator became a standard laboratory instrument, it was found that small inductances could be evaluated by shunting them with a known capacitance, and then determining the resonant frequency of the circuit. From this, the inductance was computed. This method works very well indeed for radio and *if* frequencies, but is impractical for large inductances, because few grid-dip oscillators will go low enough in frequency, and the Q of large choke coils is so low that a nonambiguous resonance point is hard to find.

There should be some method of evaluating large chokes by use of ordinarily-available shop instruments. There is! Requisites are a voltage source of known frequency, a low drain multimeter or ac VTVM, a resistor of known value, and some brains.

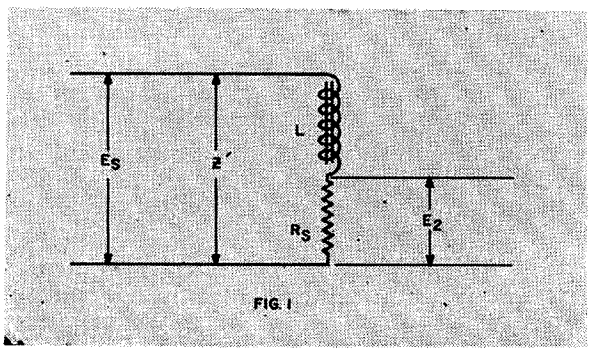


Fig. 1 Simple ac circuit containing inductance and resistance.

In any ac circuit, such as that of Fig. 1, containing both inductance and resistance, the impedance can be found from the ac adaptation of Ohm's law:—

$$1) \quad Z = \frac{Es}{I}$$

In which:—

Z = impedance of circuit (ohms)
I = current through circuit (amperes)
Es = supply voltage (volts)

Quite obviously, Es can be measured directly by use of the multimeter or ac VTVM. Current through the circuit, I, seems to be a problem at first, as few amateurs or experimenters have access to an ac milliammeter. However, known the value of Rs (we can measure it with the multimeter if necessary), and the voltage drop across it (measure it with the multimeter or ac VTVM), E_2, we can compute the current through the circuit from:—

$$2) \quad I = \frac{E_2}{Rs}$$

Substituting these obtained values in (1) gives us the impedance of the circuit of Fig. 1. Computation is simplified if we combine the formulae, by substitution, obtaining:—

$$3) \quad Z = \frac{Es\,Rs}{E_2}$$

Even though we know the impedance of the entire circuit, we still cannot compute the inductance of the choke by any reasonable method, as most chokes have a finite internal resistance, which must also be taken into consideration. Actual circuit, in the configuration of Fig. 1, taking into account the internal resistance of the choke, Ri, comprises Fig. 2. Impedance of this circuit, already found experimentally from (3), is also given by:—

$$4) \quad Z = \sqrt{(Rs + Ri)^2 + (X_l)^2}$$

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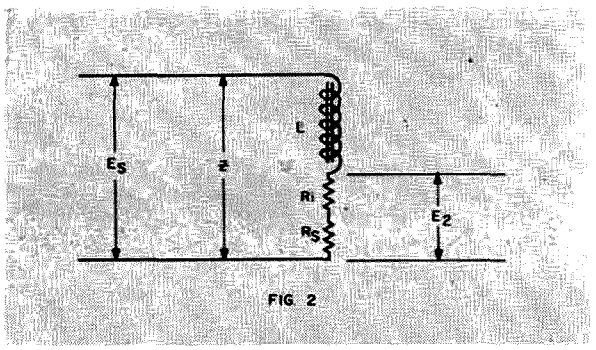


Fig. 2 Series L-R circuit including internal resistance of choke.

and, because things equal to the same thing are equal to each other, we can combine (3) and (4), obtaining:—

$$5)\quad \frac{EsRs}{E_2} = \sqrt{(Rs + Ri)^2 + (Xl)^2}$$

from which we can evaluate the inductive reactance. This can be simplified by standard algebraic methods to:—

$$6)\quad Xl = \sqrt{\left(\frac{EsRs}{E_2}\right)^2 - (Rs + Ri)^2}$$

and, as $X_l = 2\pi fL$ (f is frequency in cycles per second), the inductance can be computed directly from:—

$$7)\quad L = \frac{\sqrt{\left(\frac{EsRs}{E_2}\right)^2 - (Rs + Ri)^2}}{2\pi f}$$

The value of the inductance, L, is in henries.

At first glance, this appears to be a pretty complicated and difficult formula. Actually, as all values to the right of the equality sign are simple constants, each group of terms can be evaluated individually, and the actual computation takes only a couple of minutes. When a 60 cycle voltage source is used, the denominator, $2\pi f$, computes out to 376.9920, which becomes 380 for purposes of practical computation.

To evaluate a choke by this method, we must measure internal resistance of choke, Ri; value of added resistor, Rs; supply voltage, Es; and drop across added resistor, E_2. To illustrate with a practical example, measurements made with a specific choke are:—

Ri = 910 ohms
Rs = 1000 ohms
Es = 25 volts (60 cycles)
E_2 = 2.4 volts

Substituting in formula (7), we find that the value of the choke is 27 henries. Nameplate value of the choke (a Stancor C-1515) is 20 henries at 15 ma dc, and nameplate resistance is 900 ohms. Computations were carried to three significant figures only, as the multimeter used was dependable only to one percent.

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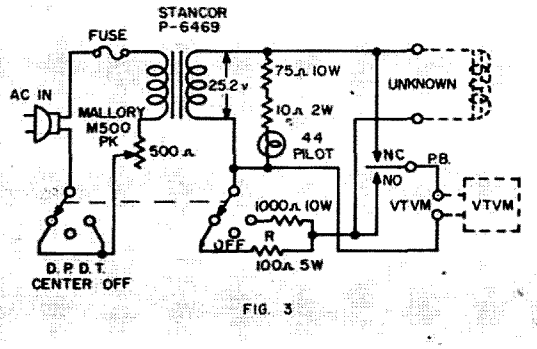


Fig. 3 Circuit of choke evaluator.

ductances, both by this method and by use of a high-grade laboratory bridge, showed that the difference between the two methods seldom exceeded two percent, which is surprisingly good when it is noted that this simplified method minimizes the effects of distributed capacity in the choke by use of low frequency (60 cycles), whereas the laboratory bridge, by a series of somewhat involved measurements and computations, is supposed to eliminate its effects entirely.

These tests also showed that the actual measurement time, including computation, was shorter with the evaluator here described than with the more complicated bridge; but the set-up time—i.e. finding and connecting the instruments and components—was about half an hour. To stop this waste of time, which adds up to a considerable figure over a period of months, the essential parts of this choke evaluator were assembled in a bakelite utility box, using the circuit of Fig. 3, and made a permanent addition to the laboratory instrument stock. Parts actually used are noted on the diagram, but electrically equivalent parts of other manuacture will work just as well. Construction is extremely simple and noncritical, there being no high frequencies, high powers, or high resistances involved. Ordinary good workmanship will give entirely satisfactory operation.

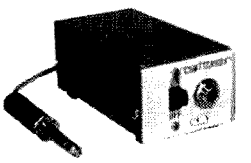


Fig. 4 Panel layout of choke evaluator.

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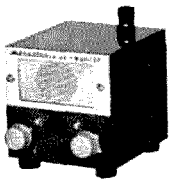
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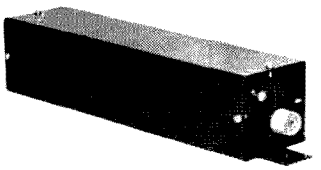
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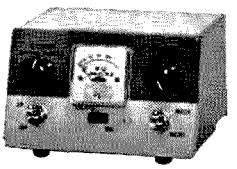
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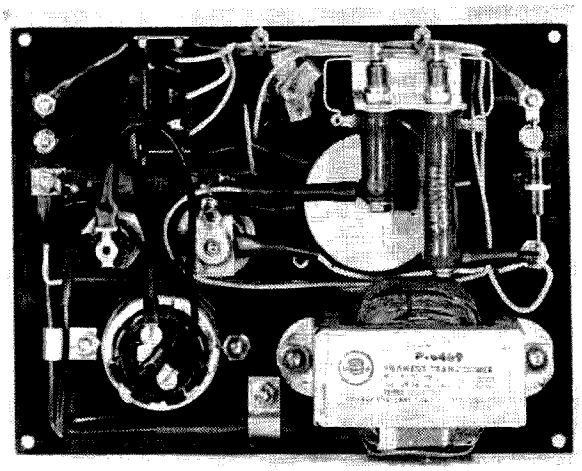


Fig. 5 Interior of choke evaluator.

Panel layout, shown in Fig. 4 is functional, and is designed for a right-handed operator. To simplify construction, and to eliminate long internal leads, all parts are mounted on the lid of the bakelite utility box (Smith #2257). Two series resistors, selectable by means of a double-pole double-throw center-off power switch, are provided, giving an effective measuring range in excess of from 0.1 henries to 100 henries. Panel labels are made on Metalphoto, by the Kohler techniques[1].

Interior of the choke evaluator is shown in Fig. 5. Construction here is perhaps more rugged than is actually necessary, but it is much easier to make things a little stronger while building than to patch and fix at a later date.

Using this device, it is possible to answer the question "How many henries" in a little less than ten minutes. Obtained answers have been found entirely satisfactory in the frequency range from 60 cycles to about 3,000 cycles. As the frequency increases, the readings become less accurate and less consistent, due to distributed capacitance and core characteristics. Because of these extraneous factors, few cored coils have the same inductance at all frequencies.

Because of these limitations, this method of choke evaluation should be limited to selecting components for power and voice frequency filters only. Components for use in ultra-high-fidelity equipment, or for supersonic frequencies, should be evaluated either by use of an inductance bridge, or by use of an evaluator built on this general plan, but having a supply frequency nearer that at which the components will be used. . . . Ives

[1]Kohler, George M. **Prototype Labels**, Electronics, Vol. 33, No. 1, Jan. 1, 1960, p. 100 et seq.

Letters

Dear Wayne:

Just a short word of sincere thanks to you for the great pleasure I have each month in reading "73." The magazine is a work of art. In particular your own column is a veritable jewel and I wouldn't miss it for a mint.

As a Porsche aficionado and ex-newspaper editor I can well understand and appreciate everything that you muse about from the joy of driving a Porsche to the relentless pressures of producing a publication. And this is not to neglect the fine technical articles you feature in each edition. All in all, "73" is far and away at the top of the ham publications list.

I hope that you have found your new quarters in that lovely, huge New England mansion to be all that you had anticipated. Your description of the move was wonderful.

Best of luck on everything!

Mark McCormack K3LOVEA

Dear Wayne:

I was aghast to note your no smokee, no drinkee stand taken in your Sept. editorial. Heavens! Don't you realize, with a clean-lifer approach like that, you are ruining your chances of appearing in Camel cigarette ads (in full color) when you're rich and famous??

The above, plus your constant humor and slightly right-of-center stand, insidiously compels me to kick in another $3.50 to see what happens next!

At the rate you are going, I can only conclude that you honestly enjoy giving Brand x and OLD MEN fits! This cannot go unrewarded! Please renew me with the Oct. issue.

Terry F. Staudt WØWUZ

Dear Wayne:

You have reached me. Here is a check to help pay the wolf before he slips on the coming ice.

From past record this is for my economic protection. Every time I go to the store for the latest 73, I end up with too many ham type goodies and a torn up copy of the word. I figure the back issues have cost me about 700 dollars.

Hope you continue the fine work in the new QTH.

George A. Howland W4AIY

Dear Wayne:

I am just back from the convention at Disneyland. WOW!!!

What's all the talk about a staff of two for 73? I went up to the "73" booth to say "Hello" to you and Virginia. First thing I know this smiling YL is twisting my arm and crooning in my ear. "So what if you do already subscribe to '73'. You can extend your subscription at these terrific convention rates." She says.

OK, Says I—"So I'll extend" Maybe even pick up a couple of back issues for some friends who are not charter subscribers."

"Back issues" she says—"Sure but don't be cheap.

3 KW PEP "BALUN" $16.95
BROAD-BAND "BALUN"
NEW! MODEL 1V5C81
ONLY $13.95
A COMPLETE MONO-BAND KIT - INCLUDES 5C1080 "BALUN", WIRE, INSULATORS AND COMPLETE INSTRUCTIONS TO PROPERLY INSTALL an 80 or 40 or 20 or 15 or 11 or 10 Meter HIGH PERFORMANCE INVERTED "V" ANTENNA
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Get a binder to keep them in." "OK"—I said—as the arm starts to turn blue.

Just then up comes good old Jim WA6EUX—"How you doing—? Gracie." He says. "Fine" she says, still smiling—just fine." "Now how about a binder for your own copies" she says, applying a little more pressure.

"O.K., O.K.," I plead, shoving a $20.00 into her eagerly waiting hand.

Please, Wayne, How many of these Green Sales Amazons have you turned loose on us? Do they all train by carrying 65 lb. packages of "73". Do they all look cute and feminine? Are they all married? Is Gracie Jim's XYL? and please can you tell me What will my 95 year old grandmother do with a life subscription to "73".???

I am very much against anonymous letters but if I sign my name I may find Gracie selling me two more maps and a forever subscription.

Dear Friend Wayne:

Nice contact the other day—sounded real FB from that new location. Also talked to one of your boys over your station a few days later in the week.

I have just been awarded the first and only Empire DX Certificate on Two Way SSB by the Radio Society of Great Britain. The award has been in existance for about 25 years and quite a few amateurs have won it on CW and AM phone, but I am the first amateur to qualify on SSB. This award took me five years to get the proper two way contacts.

Chas. W. Boegel, Jr. WϕCVU

Good work Chuck.

Dear Wayne:

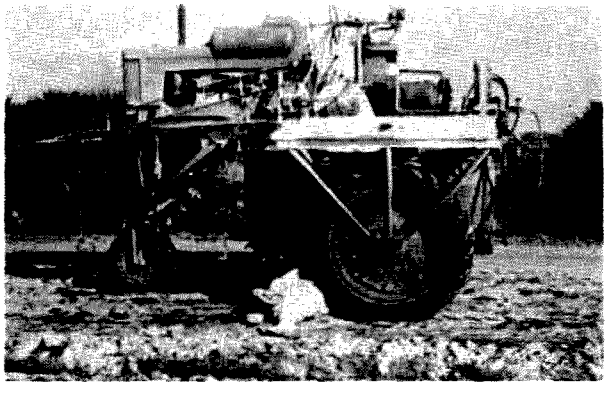
Why didn't you ask your readers to make donations to YOUR Building Fund? **Andy W3NL**

I'd rather not.

Dear Sir:

Here is a stunt I have used . . . a selenium rectifier across a key or relay stops the inductive kick that sometimes can be heard in the receiver. Both Federal and International are making units for this purpose.

H. F. Watson W3ALY



Dear Wayne:

I have, as you can see, been quite careful after subscribing to 73 for Life.

Vance V. Vogel W4OVE

Looks promising Vance. And thanks a megohm for the beautiful box of deadly nightshade fruit that you sent . . . it was delicious. Please send antidote.



Dear Wayne:

Thought you might like to see the vehicle in which your peripatetic Western Representative, Jim Morrisett, WA6EXU, mobiles about his territory. It must be seen to be believed, and even then it rather boggles the imagination.

Jim stopped by to see me one recent afternoon, but my camera wasn't handy at the time. Next morning, on my way to the office, there was Jim's Volkswagen bus, parked about 150 feet from the ocean. Had my camera along that time, and the enclosed photo resulted.

I'm not quite sure what kind of radiation pattern Jim must get from any of the antennas, but apparently they all work. The outer antennas are a stacked pair of six element two-meter yagis, and the center device is a two-meter "Dual Diversity" beam. I asked him what he did when he was mobilling along and wanted to work stations on either side of the highway. "I use the J," he said, and, sure enough, amongst that mass of aluminum tubing there lurks a J (right above the door, on the driver's side). Both Heath and Clegg VHF gear are installed in the bus.

I shuddered at the thought of high winds while traveling and their effect on this rather top-heavy arrangement, and the havoc low-hanging tree limbs could cause, but these have not—at least not yet—been problems to Jim.

And where was Jim when the picture was taken? Well, he was still sacked out in the bus (it is his mobile home-away-from-home) and if you look closely you may be able to see a big toe sticking up back there somewhere.

Richard F. Van Wickle, W6TKA
Santa Barbara, California

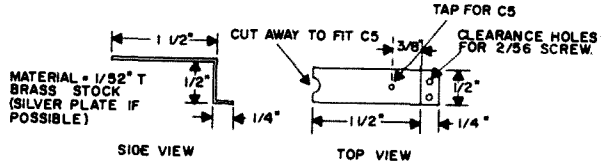
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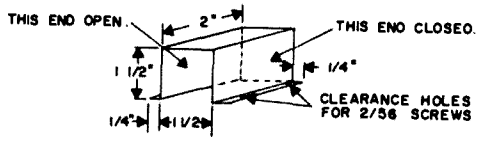
Construction Data

The entire converter was constructed on a 9½" by 5" brass plate 1/16" thick. Figs. 2 and 3 show the details of the cavity tuner. Silver plating of the cavity tuner is advisable but not essential. . . . W3HIX

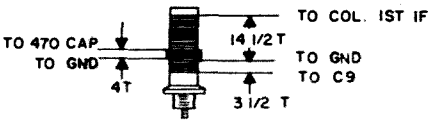
Coil Data

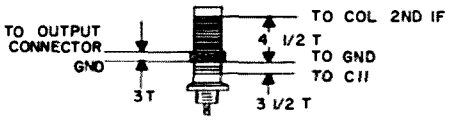
L1—7 turns #28 enam. coper wire space wound to occupy 5/16" on ⅜" dia. from slug tuned with powdered iron core.
L2—4 turns #28 enam. copper wire interwound with low potential end of L1.
L3—5¾ turns #18 tinned copper wire ½" I.D. air wound to occupy ½" output tap ½ turn from ground end.
L4—5⅛ turns #18 tinned copper wire ¼" I.D. air wound to occupy 7/16".
L6—13 turns #30 enam. copper wire spaced to occupy ½" winding area on ¼" form with powdered iron core (VHF Grade).
L7—18 turns #30 enam. copper wire close wound on ¼" form with powdered iron core, ground tap 14½ turns from collecter end.
L8—4 turns #30 enam. over low potential end of L7.
L9—18 turns #30 enam. closewound on ¼" form with powdered iron core (VHF Grade) ground tap 14½ turns from collecter end.
L10—3 turns #28 enam. wound over low potential end of L9.
L13, L14, L15—1 7/16" long ⅜" dia. copper tubing tuning screws SC1, SC2, SC3 enter the hollow copper tubing to form tuning capacitors as noted below.



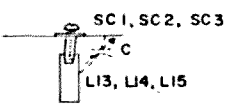


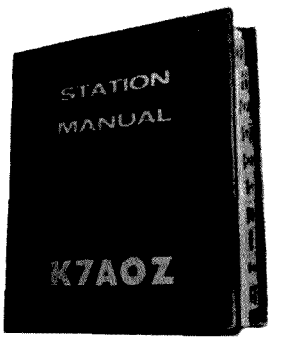
COPPER SHIELDED ENCLOSURE FOR L5





RFC 1 = 50 MC CHOKE
RFC 2 = 30 MC CHOKE





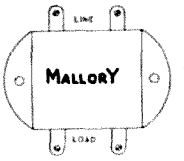
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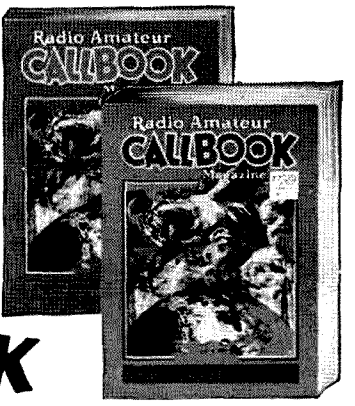


Removes A.C. line disturbances for a 5-9 QSO (wash. machines, fluorescents) used for T.V., ham receivers, Hi-Fi, moderate pwr xmtrs
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30 amps @ 115 vac
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Those Different Diodes

Staff

AT A HAM convention not too long ago, one of the speakers described the updating of a mobile receiver. Among the improvements added, he said, was a Zener diode to regulate oscillator filament voltage. At the conclusion of his talk, when he asked "Any questions?", half the hams in the room raised their hands with the same query:

"What's a Zener diode?"

The situation is a general one today; with many hams employed in the military electronics field where the phrase "state-of-the-art" is a watchword, and others in far different vocations, we're developing a technological split in our ranks. Many of today's construction articles call for strange and exotic devices which are totally unknown to those of us not working on the thresholds of the particular field involved.

In a small effort to remedy this situation, we've collected definitions, explanations, and some workable circuit information for three of the latest diode-type devices. Naturally, by the time you read this, a new crop of gadgets will have appeared — but this may at least take some of the mystery out of those *different* diodes.

Since Zener diodes touched off the whole idea, let's start with them. First, what are they? Second, what do they do?

The answer to the first question makes more sense if the second is answered beforehand: The Zener diode is the semiconductor version of the old familiar VR tube. It is used in the identical manner, current-limiting resistor and all, for the same purpose. However, it requires less room, doesn't break, and is available in a wide variety of voltages and power ratings.

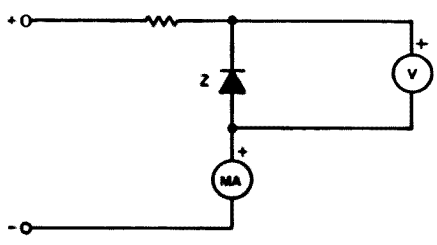


FIG. 1

Now, what is it? Basically, the Zener diode is just a conventional *silicon junction* power rectifier. All silicon junction rectifier diodes have a rated "peak inverse voltage" at which they break down and conduct in the reverse direction. If the diode is specially processed during manufacture, the voltage value at which it breaks down can be kept constant over a wide range of reverse current flow—and you have a Zener diode!

Since special processing is required, the cost of most Zener diodes is rather high. However, ordinary silicon junction rectifiers can sometimes be used as Zeners if you're willing to do some experimenting, and if the current through them is kept low (high current will burn them out instantly). For instance, the rectifiers produced by Diodes, Inc., show a particularly sharp "Zener break" just above their rated PIV.

To use a conventional diode as a Zener, hook it up as shown in Fig. 1. Start with a high value of series resistance. Note the voltage reading across the diode, and the current through it; multiply these two values to get the power going into the diode. So long as this power is less than ½ watt (for the conventional 750 ma power rectifier) the diode is safe; you can reduce the resistance by small steps, recomputing the power after each change, until you reach about two-thirds of the ½-watt level (some margin must be left for regulating action). The diode will then regulate over a wide current range, at the value you read on the voltmeter.

Note that the diode is hooked up *in reverse*, with the cathode to positive and the anode to negative. This is necessary with all Zeners, since it's *reverse* current flow that provides the regulation. Hooked up in the forward direction, they're just like any other diode except that they cost more.

Average cost (as this is written) for the least expensive low-voltage Zener diodes is around $4 each (although Hoffman produces a line of them for about 75 cents per diode); these units won't handle much more current drain than a conventional VR tube, but are available in a wide range of voltages from 3.9 volts up.

For higher current, you have a choice. You can use a bigger diode, at rapidly skyrocketing cost, or you can use the little Zener as a reference element in a transistorized regulator such as that shown in Fig. 2. Here, a small current flow through the Zener can regulate up to 3 amps through the transistor —and bigger transistors can be substituted for higher current still.

Of course, if you want to use the Zener without the transistor, you can use the circuit of Fig. 1 omitting the meters and putting the load where the voltmeter is shown.

These two basic circuits take care of nearly all voltage-regulation applications, but the Zener diode has more uses than that. Unlike the VR tube, the Zener requires no "firing-voltage" margin; it's more of a "built-in battery" as one text describes it. What's more, this battery never wears out.

Thus, you can eliminate the fixed-bias supply for a class B modulator by putting a

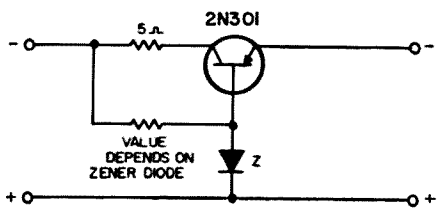


FIG 2

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The EASY WAY
No Books To Read—No Visual Gimmicks To Distract You. Just listen and learn
Based on modern psychological techniques — This course will take you beyond 13 w.p.m. in
LESS THAN ½ THE TIME
Available also on magnetic tape
See Your Dealer Now!
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Island Park, New York

IoAR

Though I have noticed a not unpredictable chill from down Connecticut way, the response to my announcement of the formation of the Institute of Amateur Radio was quite well received. The Institute has been launched and we have a lot of interesting plans afoot for it. Charter Membership, which will have some decided advantages later on, will be open only until the end of this year, but will be good for the entire year of 1963.

Charter memberships are piling in and Charter Membership cards are being sent out. Many members have good suggestions about further organization and possible activities of the IoAR . . . I think we are going to have some fun. One member suggested that we ask age on our application forms, but I have known too many 52 year old children and 18 year old adults to feel that this should be a factor.

. . . Wayne

Application for Charter Membership in the Institute of Amateur Radio
(Valid only if postmarked before January 1, 1963)

Name ..... Call: .....(must be licensed)

Address .....

City ..... Zone..... State..... County.....

Class of license: Novice Technician General Advanced Extra Conditional

Year first licensed ..... Old calls .....

Charter membership fee of $1.00 must accompany this application. This will pay dues in full until December 31, 1963.

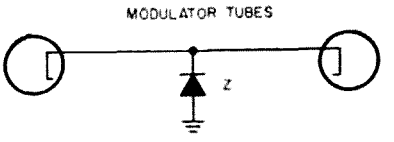


FIG 3

Zener diode (of the right value to provide proper bias) in the common cathode circuit as shown in Fig. 3. Where a conventional cathode resistor will give you a bias which varies with current drain through the tube, the Zener's voltage drop is constant so long as you don't fall below its minimum current or go above its upper current limit; most class B modulators fill both these requirements.

The same trick can be used to put fixed bias on any amplifier stage, either audio or rf. In addition, the Zener diode doesn't require any bypass capacitor, since its ac impedance is almost zero (and at any rate is far below that of most bypass capacitors).

The voltage-limiting property of this diode can also be used to build a most simple audio speech limiter for addition to any modulator, as shown in Fig. 4. Here, two Zeners must be used back-to-back; otherwise, half the audio cycle would be shorted out to ground. As in all clipper-limiter circuits, a low-pass audio filter would follow this to remove the harmonics generated by clipping.

One of the most sophisticated uses of the Zener diode is in the construction of direct-coupled amplifiers. If the Zener is put in series with a dc voltage, it will effectively subtract its own voltage drop from that voltage and pass on the rest.

Thus, if the resting plate voltage of an amplifier tube were 150, and if a 120-volt Zener were connected from the plate of that tube to the grid of the next stage (in place of the usual coupling capacitor) the voltage at the next grid would be 30.

This doesn't sound so good, but now we place a 33-volt Zener in the cathode circuit of the second tube to give a fixed 33-volt bias, and the net voltage from grid to cathode becomes —3. This is more like conventional amplifier operation — except that the circuit will respond all the way down to dc.

While such circuits aren't too useful in most ham equipment, they're occasionally essential in special test equipment. A complete circuit giving a 100-volt output swing for 0.025 volts peak-to-peak input is shown in Fig. 5.

Another new diode you've undoubtedly heard

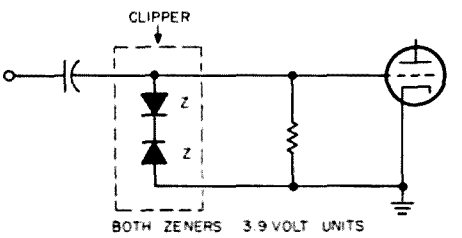


FIG 4

something about is the Esaki, or "tunnel," diode.

These little varmints can drive you crazy if you let them. Let's try to stay sane while going through the same study of them that we did for the Zeners. First, what are they? Second, what do they do?

The tunnel diode is, again, a specially-treated semiconductor junction diode. The main characteristic keeping it in the spotlight at the moment is its negative resistance under certain conditions—heretofore, negative resistance has been a tricky thing to obtain.

What does it do? Well, if you could cancel out all the resistance in a tuned circuit you would have an ultra-stable oscillator. If you cancelled out most but not all the resistance, you would have a high-gain low-noise amplifier —which would also work in both directions. The possibilities are (theoretically at any rate) limited only by your imagination.

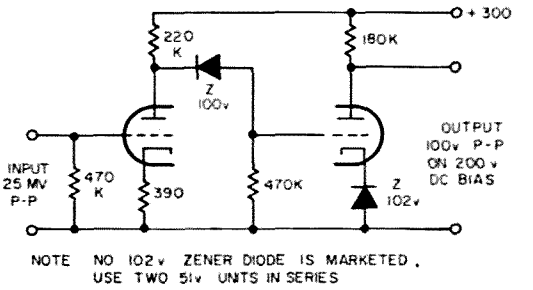


FIG 5

The trouble with the tunnel diode is that it works too well. One of the biggest problems with them is that of keeping them from oscillating at any number of frequencies simultaneously. They can amplify af, oscillate at a dozen places in the rf spectrum, and mix all the various signals together—all at the same time, without batting an atom. What's more, if you give them the slightest opportunity, they'll do it!

Fig. 6 shows a typical *theoretical* tunnel-diode circuit you can find in any textbook new enough to talk about them. If the inductance and capacitance of the tank circuit are the only reactances present in the circuit, this gadget will act as either an amplifier or an oscillator at the resonant frequency of the tank circuit. The choice of amplification or oscillation depends on the impedance of the circuit; if the impedance is lower than the tunnel diode's negative resistance value, the circuit amplifies. Otherwise, it oscillates.

The trouble, of course, is that the inductance and capacitance aren't confined to just the tank circuit where you want them. The inter-

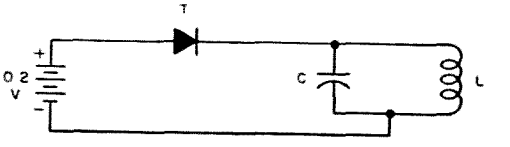


FIG 6

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1 watt 20% 6.2v	1.35
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R-f gen. purp replaces 1N82A ..	.98

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100ma	1000piv hi-V silicon	$1.70
100ma	1500piv hi-V silicon	2.25
100ma	2000piv hi-V silicon	2.95
100ma	3000piv hi-V silicon	4.45
500ma	200piv epoxy, sim. 1N2069	.30
500ma	400piv epoxy, sim. 1N2070	.40
500ma	600piv epoxy, sim. 1N2071	.70
750ma	50piv replaces 1N599	.11
750ma	100piv replaces 1N600	.20
750ma	200piv replaces 1N602	.33
750ma	300piv replaces 1N603	.39
750ma	400piv replaces 1N604	.48
750ma	500piv replaces 1N605	.60
750ma	600piv replaces 1N606	.75
750ma	700piv —	.95
750ma	800piv —	1.25
750ma	900piv —	1.50
750ma	1000piv —	1.95
750ma	1500piv —	3.25
750ma	2000piv —	4.15
2amp	50piv replaces 1N2026	.17
2amp	100piv replaces 1N347	.30
2amp	200piv replaces 1N2027	.45
2amp	400piv replaces 1N2029	.90
2amp	600piv replaces 1N2031	1.35
2amp	800piv replaces 1N1236	1.75
2amp	1000piv replaces 1N3366	2.90
2amp	1500piv replaces 1N3371	4.70
2amp	2000piv —	6.50
2amp	Cont. Rect. similar 2N1600	3.50

RECTIFIERS

2amp	50piv axial lead	$0.15
2amp	100piv axial lead	.27
2amp	200piv axial lead	.40
2amp	400piv axial lead	.85
2amp	600piv axial lead	1.20
2amp	800piv axial lead	1.60
2amp	1000piv axial lead	2.80
2amp	1500piv axial lead	4.30
2amp	2000piv axial lead	6.00
12amp	50piv replaces 1N1199	.75
12amp	100piv replaces 1N1200	1.20
12amp	200piv replaces 1N1202	1.75
12amp	400piv replaces 1N1204	2.60
12amp	600piv replaces 1N1206	3.75
12amp	800piv —	6.90
12amp	1000piv —	9.50
20amp	to 400 piv. Cont. Rect.	14.00
25amp	50piv replaces 1N248A	1.50
25amp	100piv replaces 1N249A	2.50
25amp	200piv replaces 1N250A	3.70
25amp	400piv replaces 1N2136A	4.75
25amp	600piv replaces 1N2138A	7.75
25amp	800piv —	10.00
50amp	25piv —	2.70
50amp	50piv similar 1N411B	3.98
50amp	100piv similar 1N412B	5.98
50amp	200piv similar 1N413B	6.50
50amp	400piv —	9.75
50amp	600piv —	16.00

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connecting wires have both self-inductance and capacitance both to ground and to each other. The diode itself has some inductance and capacitance. So does the power supply. And every possible resonant circuit with an impedance greater than the diode's negative resistance produces oscillations!

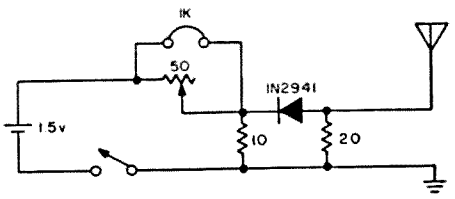


FIG. 7

One way of getting around this problem, by brute force, is that shown in Fig. 7. This circuit may be familiar; it's from "Lost In a Tunnel" in our January, 1961, issue. Here, the 10-ohm resistor in the power supply swamps out any possible oscillations there, while the 20-ohm resistor swamps out the undesired oscillations in the rest of the circuit. Somewhere around 50 mc, the inductance of the 20-ohm carbon resistor and its own capacitance to ground form a resonant circuit with impedance great enough to force oscillations, and the result is a 50-mc-or-so sine wave with nearly 1-volt peak-to-peak amplitude. The headphone is used as a mike to modulate the rf.

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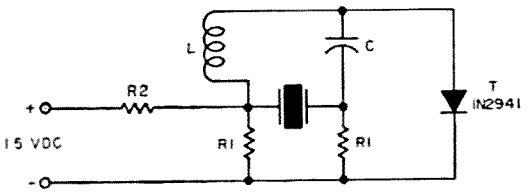
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$R_2 = 5\ 1/2 \times R_1$

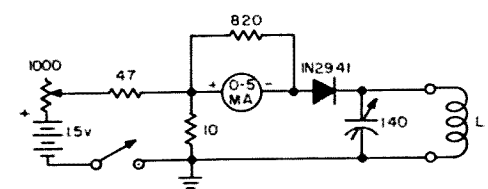
FIG. 8

This circuit is an interesting laboratory curiosity, but isn't too useful. More quickly adaptable to our uses is the crystal oscillator of Fig. 8, developed by GE engineers. In this one, resistors damp out all oscillations except at the crystal frequency. At this frequency, the crystal bypasses some of the resistance and allows oscillation.

Recently, the Heathkit people came out with a "tunnel dipper," similar to the familiar grid-dip meter. One circuit for such an instrument is shown in Fig. 9. Since we haven't tested it, we can't guarantee results—but the fact that Heath sells such a product means that it can be made to work.

When working with tunnel diodes, you'll have to get used to dealing with minute voltages and currents. All the interesting action takes place with voltages of about 50 to 300 thousandths of a volt across the diode! Many meters won't read accurately in this region; the bias-supply circuit of Fig. 10 is recommended to make sure that your supply voltage is at least in the right township.

So far, we've looked at diodes which amplify,

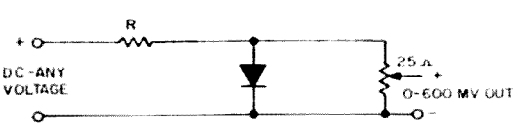


L PLUG-IN COIL TO RESONATE WITH TUNING CAPACITOR AT DESIRED FREQUENCY

FIG 9

5-18mc 40 turns #20, ½" dia, 1¼" long (B & W 3004 or Air Dux 432T)
12-45mc 16 turns #20, ½" dia, 1" long (B & W 3003 or Air Dux 416T)
43-160mc 3 turns on #20, ½" dia, 3/16" long (B & W 3003 or Air Dux 416T)

Start with 1K pot at max. resistance, decrease its setting slowly. Meter reading will increase, then decrease. Set for approx 3 ma reading in decreasing portion. Pot need be adjusted only when battery ages or is replaced.



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FIG 10

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diodes which oscillate, and diodes which behave like batteries. How about the diode which acts like a variable capacitor?

These are known by many trade names. Pacific Semiconductors Inc. calls their version "Varicaps," International Rectifier calls them "Semicaps," and Amperex uses a string of words: "Silicon Variable Capacitance Diode." Hughes shortens this to "Silicon Capacitor," but they're all talking about the same kind of a diode.

In many ways, the "silicon capacitor" is like a Zener diode; it is effective only when reverse-biased, and it requires special processing. However, unlike the Zener, the silicon capacitor is never used in the breakdown region, so it never carries any current. Let's approach it from the same viewpoints: First, what is it? Second, what does it do?

Like the Zener diode, the silicon capacitor is a silicon *junction* diode, specially processed for the desired characteristics.

Unlike other diodes, the silicon capacitor behaves like a variable capacitor. When reverse-biased, it has a certain capacitance. Just how much capacitance depends on the voltage across the diode.

As you probably know, a reverse-biased diode looks like an open circuit; now, the definition of a capacitor is also that of an open circuit: two conductors separated by an insulator. The amount of capacitance depends on how far the conductors are separated.

In the silicon capacitor, the insulator is

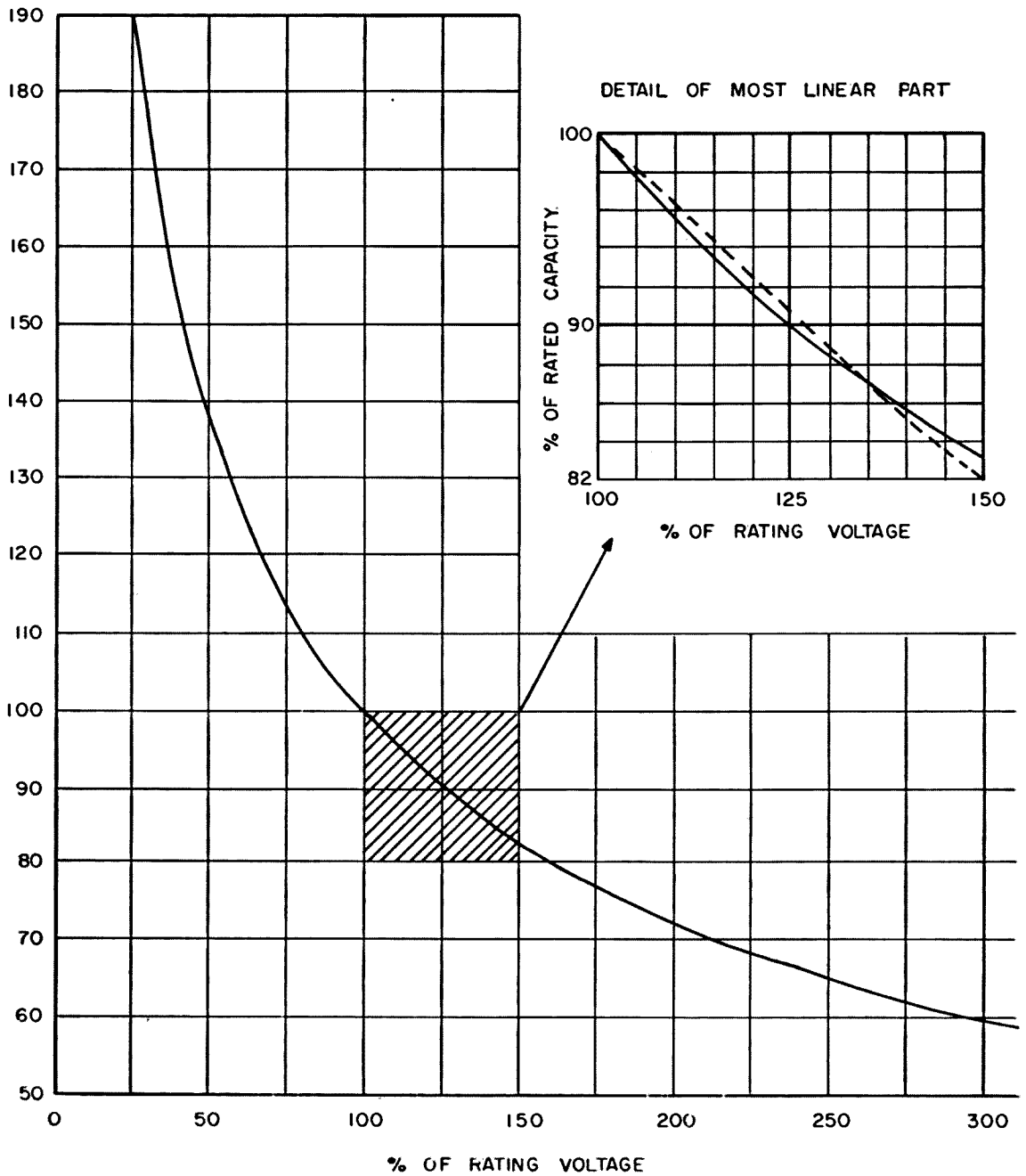


FIG 11

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furnished by what physicists call "the depletion layer" at the junction. The thickness of this "depletion layer" depends on many things; among these factors are the way in which the diode was processed during manufacture, and the voltage across the junction.

Note those last five words: the voltage across the junction controls the thickness of the insulating layer, or in other words, the distance between conductors—and thus, the capacitance. It works something like the familiar mica compression trimmer, except that voltage controls the capacitance.

If the preceding three paragraphs suggest to you that any silicon junction diode can be used as a silicon capacitor, you're right. However, the specially-processed units often have a greater range of capacitance, and in addition, can be obtained in known values.

The actual amount of change in capacitance with change in voltage follows a rather complicated set of equations; the graph in Fig. 11 shows this change in "normalized" values. If you know the capacity of the diode at any one voltage, you can find the percent change in capacity with percent change in voltage from the graph. Thus, a diode with 22 mmfd capacitance at 7 volts bias will have 14.3 mmfd at 250 percent of 7 or 17.5 volts, and will show 33 mmfd at 2.8 volts (40 percent of 7). This chart is accurate for all diodes, even though various manufacturers rate their units at different bias voltages.

The circuit for using a silicon capacitor is shown in Fig. 12; the silicon capacitor is the symbol which looks something like a diode and something like a trimmer. You can see that the only difference between this and a conventional tank circuit is the dc-blocking capacitor in series with the silicon capacitor. If this blocking capacitor is very large in comparison to the silicon capacitor (10 times or larger), it will have no noticeable effect on the capacitance in the circuit.

Going back to Fig. 11 for a moment, you can see that the change in capacitance is almost exactly proportional to changes in voltage over any very small range. The most linear part of the curve has been expanded for the region from rated voltage to 150 percent of rated voltage; over this spread, the departure from true linearity is no greater than 0.5 percent, which immediately suggests the use of these capacitors for tuning oscillators and receivers.

As a matter of fact, the new Hallicrafters FPM-200 is tuned in just this way, and several articles on use of the silicon capacitor for automatic frequency control have been published as well.

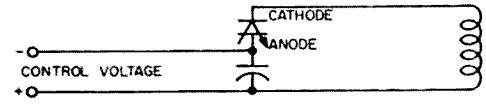


FIG 12

A bit of thought will remind us, though, that the frequency of an oscillator is *not* directly proportional to the capacitance in the tuned circuits; for very small changes, it is, but for large changes, the calibration is far from linear.

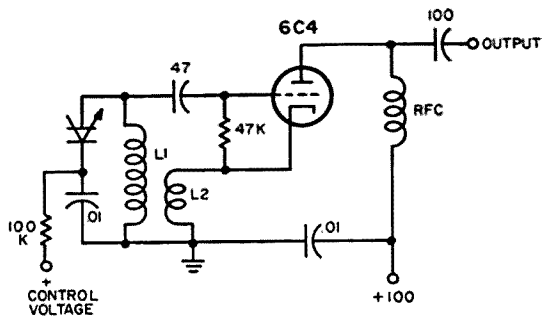
Fortunately, if a silicon capacitor is used in an oscillator tuning circuit, some of the non-linearities cancel each other out. Fig. 13 is a graph of frequency versus voltage for the circuit of Fig. 14; the dotted line is a true linear calibration while the solid line is the actual calibration curve. You can see that the departure from linearity is a very small part of the actual tuning frequency.

Like Fig. 11, Fig. 13 is "normalized" to starting conditions. Thus, if the circuit tunes to one frequency at a given voltage (say, 7 mc at 5 volts) it will tune to 105 percent of that frequency (in the example, 7.35 mc) at 123.5 percent of that voltage (or 6.7 volts).

The linear region of the curve isn't quite long enough to cover the entire 80-meter band at one setting, but is more than adequate to cover all our other bands; you can set your frequency with a voltmeter.

The advantage of such a hookup is primarily that you can now put the rf-carrying leads right where you want them; the tuning is done with dc, which can (and should) be decoupled with high-value resistors, allowing you to put the tuning controls wherever you like.

A word of caution: all these characteristics hold *only* when the diode is reverse-biased. If the rf voltage swing across the capacitor is



L1 - VALUE DEPENDS ON FREQUENCY DESIRED; SLUG-TUNED COIL IS SUGGESTED.

L2 - 1/4 AS MANY TURNS AS L1, WOUND OVER COLD END OF L1 IN SAME DIRECTION; ADJUST NUMBER OF TURNS AS NECESSARY FOR STABLE OPERATION

FIG. 14

greater than the dc bias, anything can happen. This can be prevented by tapping the diode down on the coil, or by using circuits which do not put a high rf voltage across the diode-capacitor.

In addition, voltage must be closely controlled. In our example above, it took only 1.7 volts change to swing the frequency clear across the 40-meter band; a 0.17-volt change would move you 35 kc, and just 17 millivolts would swing the frequency 3½ kilocycles—outside the bandpass of many receivers. This effect can be put to use to get FM the simple way (see the references) but is quite a headache when it happens unexpectedly.

In a single issue of this magazine, there's not room to do more than scratch the surface

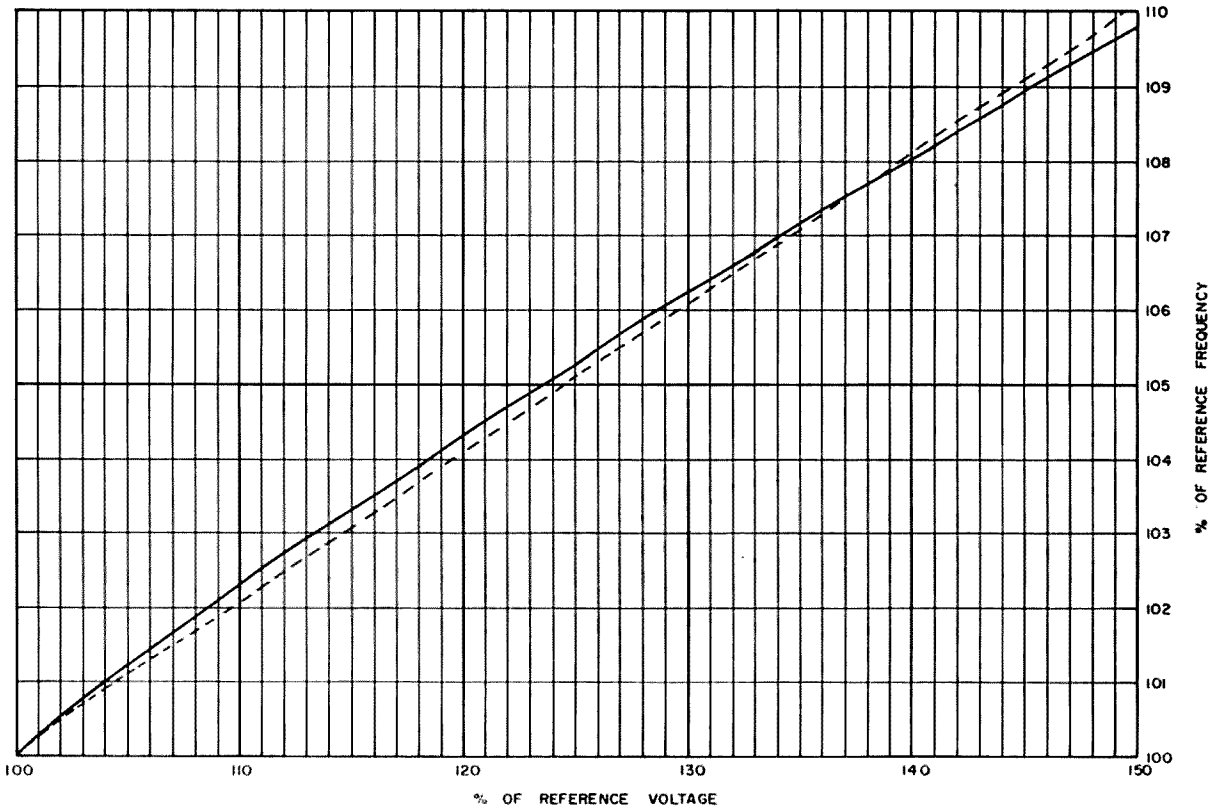


FIG 13

of the strange world of semiconductors. A number of other exotic semiconductor devices have been announced in the past few months: the thyristor, the binistor, the unijunction transistor, the four-layer diode, the silicon-controlled-rectifier, to name but a few. The only way to keep up with them all is to read the dozen or more high-level engineering publications, including three devoted to semiconductors exclusively—but at least, this may have taken some of the mystery from these three *different* diodes.

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DPDT Relay 115vac/60cy coil, ceramic insulation, Leach #1177BF 10 amp contacts, NEW **$3.95 delivered**

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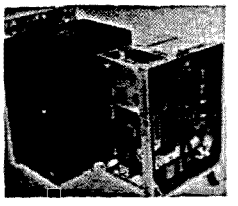
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Same, in handsome cabinet w/pwr sply. spkr. etc., ready to use, is our QX-535, 19 lbs. $37.50

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Box 1220-GC BEVERLY HILLS, CALIF.

A Good Five Cent QSO

George Thurston W4MLE
3407 Prock Drive
Tallahassee, Florida

WHAT this hobby needs is a good five-cent QSO.

We have plenty of the 50 cent variety—the kind we're all familiar with, which last a minimum of 15 to 20 minutes and consist entirely of an exchange of signal report, name, QTH, a description of the rig (in greater or less detail), a run down on the local weather. And the final five minutes is an exchange of totally banal fond farewell, as though you might mortally insult the guy at the other end by just signing off with him.

"Well OM, guess I better QRT pretty soon. The Jr OP just fell out of the tree and seems to have broken his leg. So thanks a lot for the QSO. Hope to see you again before too long. Sure has been pleasant. Oh oh. XYL just called chow so 73 DX. Good luck. 73 now Tom OB SK K4XXX DE W4MLE 73 GN GL DX SK GE DIT."

We need a procedure signal meaning "I don't want to make RCC. I just want to swap sig reports and scram." Some one has suggested "QCQ" for this purpose. Perhaps you could call CQQ CQQ CQQ DE— and in answering another station's CQ, you might try "W4MLE DE W4XYZ QCQ."

This style of operating—similar in some ways to contest style used in Sweepstakes, CD parties and DX contests—offers many advantages both on phone and CW.

One of my favorite sports is to pick a relatively clear spot (if I can find one) on 40 or 80 CW and call CQ using complete break-in (QSK):

CQ CQ CQ DE W4MLE BK CQ CQ CQ DE W4MLE BK CQ CQ CQ DE W4MLE BK and so on until someone answers. The reply to his call goes "W7YYY DE W4MLE GE UR 579 TALLAHASSEE FLA NAME GEORGE BK"

And W7YYY almost alawys will reply in

FALL SURPLUS SPECIALS DE K2BBC

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DB Meters 3½" rd —10 to +6db 1mw @ 300 ohms	NEW	$2.75
Sperti Vacuum Switches for ART-13, etc.	NEW	$1.00
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Chargers for above (12v) 115ac input		$4.95

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6161	$35.00	250TH	$18.50	6146	$2.95
829B	$9.50	6159	$3.75	446A	$0.50

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We stock large quantities of Military and Commercial Test Equipment. We buy AN/GRC, PRC, TRC and test equipment TS and AN/UPM or URM. What have you for sale or trade?

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3 bands 240 to 2000 kc—115vac
New condition ---------- $69.50

BC-463A Transformers and Modulators converts to 6 mtrs. uses 815 tubes. New ---------- $19.50

Coax Relays SP3T 28vdc
General Communications 3N120RC or Thompson Products 10566. New ---------- $17.95

Bird Model 6250 Milliwattmeter
0-250mw, 30-500 mc, for Handi-Talkies
New ---------- $42.50

kind, often dropping a word about rig, weather or a comment on a new antenna, a question about conditions, DX, traffic or something else.

The QSO usually lasts 3 to 5 minutes because unless it shows promise right away, I "73" the other op on my second transmission. SK is immediately followed by QRZ? And it is surprising how often this will bring an immediate call from some operator who has been reading the mail. Otherwise, the CQ BK is resumed.

Occasionally this has produced eight or ten QSOs or more in an hour of operating but more often the third or fourth—and sometimes the first—of such a series strikes a spark and some really collossal QSOs result.

The third of one such series raised VE3AWE one night and the QSO lasted 56 minutes. Another series produced K2UKQ and Kay and I have had many pleasant QSOs since then.

The first CQ BK not long ago produced W4IEI and the resulting QSO lasted more than two hours and a half and was repeated in similar length the following night and a shorter one (only two hours) two nights later.

Far from being "anti-social," the quick QSO is a fine way to add many new friends. They come around more often for second QSOs if they weren't bored to death the first time.

A K3 called me one evening and got the stock "UR 579 TALLAHASSEE FLA NAME GEORGE BK" and reproached me with "are you in a contest or something? I try to make friends in my QSOs, not just fill my log with numbers."

Before telling him I had just finished a 75-minute QSO with a perfect stranger I asked my K3 friend whether he considered brevity unfriendly.

Is it more friendly to say "UR 579 TALLAHASSEE FLA NAME GEORGE BK?" Or to say "R R R R R GE OM TNX FER FB CALL UR SIGS HR 579 579 579 HR IN TALLAHASSEE FLA THE CAPITAL CITY OF THE SUNSHINE STATE? TALLAHASSEE FLA? TALLAHASSEE FLA BT THE HANDLE HR IS GEORGE? GEORGE? GEORGE BT SO HWS THE WX THERE IN K3 LAND OM? AR K3XXX DE W4MLE?"

They both convey exactly the same information. So why is the five minute variety "friendlier" than the ten second variety?

Certainly the latter approach is more time consuming if the object is sheer length in QSOs.

But I'm inclined to like the briefer and friendlier ones. . . . W4MLE

(W2NSD from page 4)

of a screen dropping resistor, self biasing and a clamp tube would even eliminate the need for the two surplus supplies. The 2000 volts (modulated) come from an old National 600 transmitter, vintage 1937. The power supplies from Meshna replaced a couple of bread-board supplies that I whipped up the last time I ran the final back in Brooklyn in 1956-7-8. It makes it neater. By judicious surplus scavenging and a careful eyeballing of the ham ads you should be able to duplicate my feat quite reasonably.

Once you are on two meters with higher power you will find an entirely different operating world from the Twoer-Halo type of operating. When the band begins to open up you can be in there working the weak ones. When aurora starts you can get answers to your calls. It may be fun to sit there calling station after station, only to hear them come back to someone else, but it doesn't in any way match the fun when they come back almost every time you call. It is worth the effort necessary. Like all other things in this life, you get fun out of ham radio in proportion to the effort you put in.

FM

Our article on the Friendly Frequency in the June 1962 issue of 73 has resulted in a lot of mail and considerable interest. We are preparing a booklet on the conversion of the AN/VRC to six meter FM, which should get a few more fellows interested. In case you are fuzzy on this, there are several hundred fellows set up on 52.525 mc wide-band FM around the country. Most of them are using converted Motorola gear and surplus gear. The idea is to have a completely separate station with sqelch set up on the calling channel so that anyone calling in will have someone or group to talk to. It sure helps tie clubs together and adds a new dimension to mobile operating in cities. Jack Cunkelman W3JKE has published a listing of the FM nets all over the country and the individual stations active in these nets. He also lists the phone number and type of equipment used by each station. It is quite a list and should be in your car if you travel and are set up for 52.525 mc. Copies may be obtained for 25¢ each from Jack.

Anthem

The anti-communists are still in there pitching, trying valiently to sacrifice ham radio for a few moments of their own personal glory. What ever happened to the Old West where they went to lynchings instead of drive-ins? Come on, California, clean up those nuts.

It is heartening to see that the FCC is clamping down on the broadcasting of political nonsense from these guys. I hope they scuttle that incredible request to allow us to play the National Anthem twice a day which has been sent as a petition to the FCC. I can just hear 20 meters now with 100,000 amateur radio stations playing the Anthem twice a day, seven days a week . . . you wouldn't hear much else. With a market like that you can bet that some record company would come out with a long-play rendition of the Anthem that would run 45 minutes.

Ham radio is a fine hobby . . . let's not ruin it with nationalism. We know we have a great country and this comes through every time we talk to a DX station. Let's sell ourselves that way. Let's not try to sell politics, religion and other relatively unsalable items over the air. If you have an urge to sell, dissipate it by selling all comers on the advantages of subscribing to 73.

Mobile Monitor Scope

A reader advises that the 2BP1 or 2BP1A are better alternatives for the obsolete 913 specified in the article in the August '62 issue of 73 than the suggested 2AP1, which requires a higher anode voltage.

Flagging Interest

There were several interesting things in the July issue of CQ (no fooling!). #1 was the USA-CA column by K6BX. This column started out with two waving American flags and reached a crescendo with a huge full page reproduction of the actual USA-CA award certificate, which features not only a large American flag a waving, but all fifty of the State flags. In this day and age where we are used to seeing the American flag being waved more by charlitans and subversives of the far left and far right, it is nice to see someone with honesty and purity in his heart using the American flag as a rallying point.

Further along in this column Cliff has a flash announcement that we are coming out with some sort of award which will do away with all other awards. Good for us.

There are several questions which the column did not resolve for me though. (1) Who originated the idea of an award for working counties? (2) Did Charlie Vogelsong W3BQA send the idea for this award to K6BX together with the rather complete set of proposed rules which were later published as K6BX's? (3) Did this award pave the way for K6BX to

get a position on the CQ staff? (4) Did K6BX offer W3BQA USA-CA Certificate Number One in return for his not revealing the situation leading up to the announcement of the new award? (5) Was Charlie foolish to turn down this great honor and thereby miss out on being the feature attraction at the Dayton Hamfest dinner? (6) Are the USA-CA awards all legitimate? (7) What will happen next? (8) Did you know that there is a fine wall-sized map of the US showing all counties available from the Gov't Printing Office and put out by the Dept. of Commerce?

Advertisers

It is encouraging to note that several advertisers have had such good success with 73 that they have decided to run all further ads in 73. Each month there are a few new advertisers who are testing the ability of 73 to sell their products for them. Since it is these advertisers who are buying your magazine for you (the newsstand and subscription price doesn't begin to cover printing costs) it sort of behooves you to take more than a casual look at the ads and to talk up 73 with any advertisers that interest you. Just a few more ads and we will be able to expand the magazine and bring you more pages of articles each month. I call your attention particularly to our Surplus section of the magazine. We have the largest collection of surplus ads of any radio magazine and it will stay that way if you keep after them. Barry, Meshna, Rex, TAB, Goodheart, Verns, Hi-Way, Fair, US #1, Space, Columbia, Candee, JJ Glass, Signal, Jefftronics, all have some great buys. Don't miss the catalogs they put out and stop in to see them if you can. I visited Meshna recently and really loaded up the car . . . what a collection he had. The new Barry catalog eats your heart out. Fair has a terrific selection, ditto Columbia and Candee.

73 TESTS

Perspicacious readers may notice that we have more than the usual sprinkling of tests of new gear this month. There are obvious reasons for the spate at this time. 1) The increased sales which these test reports might bring on will undoubtedly result in a much merrier Christmas for the manufacturers involved . . . and this may just result in a merrier New Year for us when the new ad contracts come in. 2) The test reports are very handy for you to use as a sort of shopping list for the XYL and harmonics for Christmas Buy them one each of the products tested and watch their surprised expression on Christmas morning.

COLUMBIA GEMS!

SPECIAL! 144 or 220 mc TRANSMITTER

20 watts! Simple to convert 242 mc DXT-2 Beacon Transmitter, measures 4" x 4" x 11" complete with antenna, water-tight case and sidetone modulator. Power required 300V DC & 6.3V. Uses two 12AT7 and one 6360 final (not furnished). Schematic and 2-meter conversion data included. Hundreds sold already at this fabulous price. BRAND NEW, only **6.95**

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Spare Parts Kit for above, consisting of Transmitting & Receiving Dynamotors, Relay, Choke, Brushes, Fuses, etc. NEW.....$4.95

12-24V INVERTER. No more bother to change surplus 24V gear to 12V! Just use this converter, feed in 12V, output supplies 24V @ up to 4 Amps. Enough to operate 24V Xmtr & Rcvr without internal changes. Compact metal container 4½" x 10" x 7". ONLY.....$8.95

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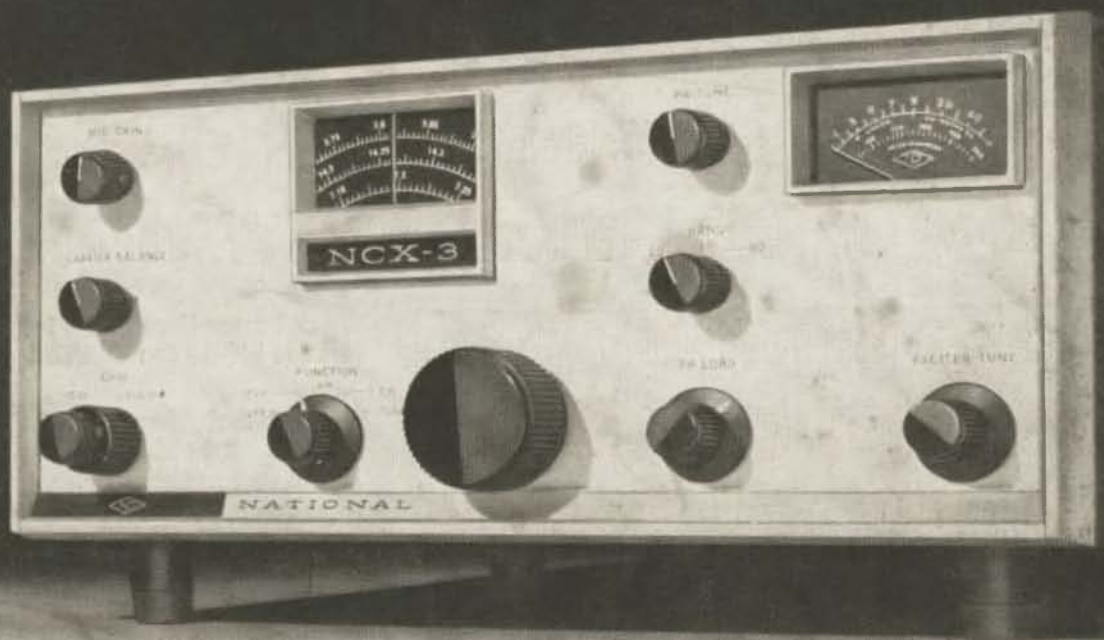
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NCX-3 SPECIFICATIONS

Frequency Range: 3.5, 7.0, 14.0 Mc. amateur bands •Types of Emission: SSB (LSB 80 and 40 meters, USB 20 meters), AM (SSB with carrier inserted), CW •R. F. Power Input: 200 watts SSB PEP, 180 watts CW, 100 watts AM •R. F. Power Output: 120 watts SSB PEP, 108 watts CW, 30 watts AM •Output Impedance Matching Range: 40-60 ohms •SSB Generation: 5200 Kc crystal filter; bandwidth 2.5 Kc at 6 db •Frequency Stability: 400 cyles long-term after warm-up •Suppression: carrier —50 db; unwanted sideband —40 db •Operating Facilities: all modes —full AGC and S-Meter on receive; SSB-VOX or PTT transmit, product detector on receive; AM—VOX or PTT transmit, separate diode detector on receive; CW — grid block break-in transmit, product detector on receive •Audio Input: High impedance, low level •Controls: Front panel — Main Tuning, Band Selector, Audio Gain, R. F. Gain, Microphone Gain, Mode (off, SSB, AM, CW, tune), Carrier Balance, Driver Tune, PA Tune, PA Load; Rear panel — Vox Sensitivity, Anti-Vox, Vox Delay, Bias Adjust, Vox Input, PTT Input, Key, Phones, Ext. relay •Metering: PA cathode current on transmit; S-Meter on receive •Receiver Sensitivity: 1.0 μV. for 10 db S/N ratio •Receiver Selectivity: 2.5 Kc at 6 db •Receiver Audio Output: Better than 2 watts; 3.2 ohms •Size: 6" H., 13¾" W., 11-¾" D. •Shipping Weight: 20 pounds •Power Requirements: 700 V.D.C. @ 300 ma., 280 V.D.C. @ 100 ma., —80 V.D.C. @ 10 ma., 12.6 V. @ 5A. •Tube Complement: 17 tubes, 4 diodes; parallel 6GJ5's in final amplifier. Mechanical: ⅛" solid extruded aluminum front panel; perforated steel enclosure; cadmium plated steel chassis; chromium plated steel mobile mounting bracket. •Main Tuning Ratio: 45:1, employing planetary and split gear drive. •Finish: Front panel — Hydro-etch off-white matte with brushed aluminum trim; Knobs — Mil-Spec, matte black; Enclosure — gray-blue wrinkle enamel. •Accessories: NCXA 115 V.A.C. power supply/speaker console; NCXD 12 V.D.C. power supply

New NCX-3 only $369

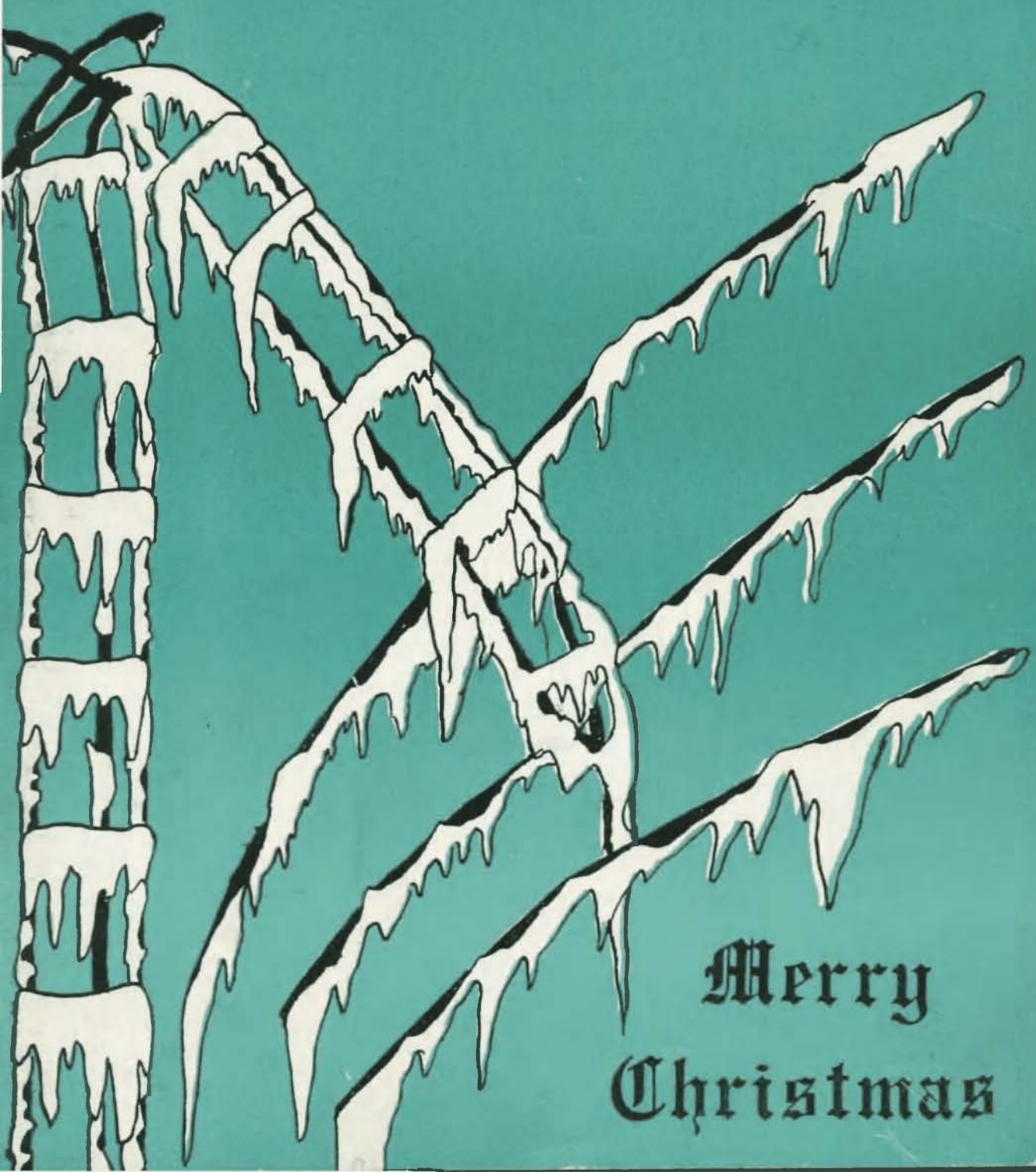
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AMATEUR RADIO

73

December 1962
A Jolly
40¢



73
Magazine

Wayne Grean, W2NSD
Editor, etcetera

December, 1962

Vol. XIII, No. 1

Cover: W1MEL

Two Meter VFO W6TKA 6
Very stable and uses one tube. Dandy bandspread.

Modifying the Sixer K4ZQQ 9
For a 50% power increase.

Modifying the HE-45 ..... WA2INM 10
Improving the modulation & power output meter for this nice rig.

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Not very hammy. Tachometer, dwell angle meter, battery VM, temp. indicator.

Coaxial Baluns WA2INM 26
Open wire is the lowest loss, but how do we get from coax to open line?

Selectivity Plus W6EUM 28
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The Heath HR-20 ..... W4WKM 36
73 tests the Heath mobile receiver.

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Complete portable CW station.

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Fiction.

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Squelch is very handy and this circuit is so simple you have no excuse.

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de W2NSD/1

Never Say Die

The Institute

Many interesting suggestions for activities of the Institute of Amateur Radio have accompanied the membership applications. It is entirely possible that the Institute may take a rather active part in the encouraging of some of the more obscure phases of amateur radio such as wide-band FM, Ham-TV, amateur repeaters and the like. We are open for further suggestions.

One of the first projects of the Institute is the projected Ham Flight to Europe which is beginning to take shape. We are trying to arrange a minimum cost three week trip which will include London, Paris, Berlin, Geneva and Rome. This would give us about four days in each city, which would allow us time in each city to meet the local hams in a big hamfest, see the city and visit a few local amateurs. We hope to be able to fly you over on a jet, take you from city to city, take care of the hotel bills and many of the meals, all for around $500. As we talk further with the airlines we will find out how far off we are.

London seemed like the most promising first stop since the language can be learned in a few hours, at least well enough to make do. This is one of the most wonderful places in the world to shop for men's clothes . . . and the prices are quite reasonable.

Next stop Paris. Bring lots of film. Virginia will have some hints for the XYL's on shopping in Paris. I'll give you the low down on some magnificent but inexpensive restaurants. You won't want to miss one of the most fabulous night club spectaculars in the world: the Lido. This is heady stuff for ministers and scout masters, but everyone else should have something to remember for life. We'll try to have a first class hamfest here, too, so you can meet the French amateurs and perhaps talk one of them into driving you through Paris in his deux-cheveux. You won't forget that, either.

Geneva, Switzerland, will probably be our next stop. I hope you and the XYL saved some money back in Paris for you will find one of the most international shopping areas in Geneva. Not far away is Mt. Blanc where you can enjoy one of the most exciting tramway rides in the world.

Rome! You'll love it. Don't drink from the fountains . . . I tried it. Rent a Vespa and see all of Rome for yourself. Wait'll you try real Italian ice cream . . . mmm. I'll have some hints on restaurants here, too. Stand by for one of the best meals you've ever had.

Last of all, if we can manage it, will be Berlin. We may have to settle for Frankfort. Berlin is an experience . . . you can visit the Eastern zone and see for yourself what a dead city is like. The department stores of Berlin are overflowing with marvelous merchandise selling at fractions of what we would expect. The XYL's will see some beautiful dresses here . . . and furs. You may be more interested in rounding out that, ahem . . . collection of foreign slides.

Virginia and I are convinced that everyone should make plans to visit Europe, no matter how difficult it may be. Once you make up your mind the only problem is how to manage . . . and somehow you do. Even if you have to go now and pay later it is well worth it. This, essentially, is what we did when we went over in April . . . and we don't regret one minute of it!

Since it is necessary for you to have been a member of a club for at least six months before you can accompany that club on a charter flight it would be prudent, if you have any

Application for Charter Membership in the Institute of Amateur Radio
(Valid only if postmarked before January 1, 1963)

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Address .....

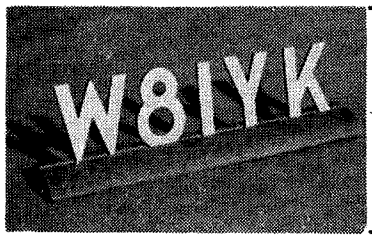
City ..... Zone..... State..... County.....

Class of license: Novice Technician General Advanced Extra Conditional

Year first licensed ..... Old calls .....

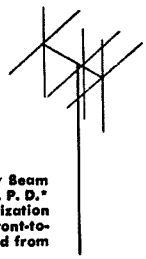
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73 Products

MICKEY MIKER 50c

This is the first of our small booklets to come off the press. It is a complete description of the construction and operation of a little device which will measure capacity to a high degree of accuracy. This is a gadget that can be built out of most junk boxes and will forever be a handy item to have around when you are building something new or fixing something old.

SSB TRANSCEIVER SCHEMATIC $1.00

There have been many requests for a giant sized schematic of the wonderful little transceiver that appeared in the November 1961 issue of 73. This schematic comes complete with a spare issue of the magazine in case you missed it.

MRT-90 CONVERSION: 50c

This booklet gives complete conversion instructions for converting the little pack-set surplus units into a fine two meter walkie-talkie. An article appeared in 73 on this unit in the October 1961 issue.

73 Peterborough, N. H.

idea of possibly going along on this flight, to send in your membership application to the Institute immediately. We can only take 150 maximum on the trip and date of membership will be used as a means of accepting flight reservations should there be too many. It is only necessary for the OM to join the Institute for this automatically includes the XYL.

It is not necessary to cut your magazine. Send the information from the membership application together with one dollar and your membership card will be sent. Charter Memberships are available only during 1962. The rather startling benefits of Charter Membership will be announced once it is too late for everyone else to sign up for them.

Christmas Instructions

Perhaps I should let you know that I have been promising our advertisers that you will be spending up a storm this Xmas (keep the X in X-Ma$, as they say). The only honorable thing to do, really, is buy an extra receiver or rig and try to keep me from making such rash promises again.

Actually, this Christmas thing can be used to your advantage if you are a little crafty. You can start out by grumbling about Christmas, just as you always do, and then, in a sudden flash of genius, propose their getting one big thing for you instead of the usual pile of sox, ties, shirts and slacks. How about our finally getting that really great receiver which would make all the difference in the world in the operation of the station? What can she say? If you've already packed in a new receiver in the last few months and things are still a little tender over that extravagance then you might as well shoot for one of the new transceivers. If you word it right, with just a hint of tear in the eye, I'm sure that you can get the whole family to kick in and make this Christmas one to really remember. Don't forget that people get enjoyment out of giving . . . make them happy, let them give you (with your money) something *big*.

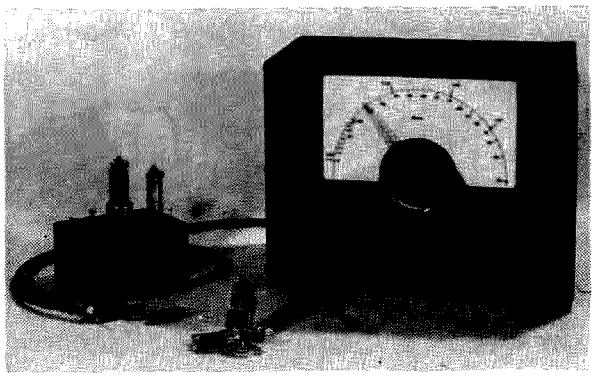
This gambit doesn't work nearly as well during the rest of the year and you will probably find yourself bribing the XYL with a couple of new dresses or a trip to get the okay. No, take advantage of all the Christmas Spirit and use it.

Too Much

Luckily I am no longer on the mailing list of that sick California nut farm calling itself the Anti-Communist Amateur Radio Network.

(Turn to page 82)

Richard Van Wickle W6TKA
643 Aurora Avenue
Santa Barbara, California



A Stable, Two Meter VFO

ALTHOUGH WE'RE USED to scooting around the lower frequencies with ease, our wings are usually clipped when we venture much above 10 meters because, as you've probably noticed, the schematics for the VHF transmitters usually specify 8 or 24 mc crystals instead of a VFO. This is basically because there are very few VFO's which have sufficient stability to make them suitable for VHF use. The VFO which I am about to describe is one of the few which you can use on two meters and have reasonable assurance that you are on the frequency you think you are on.

The higher in frequency we go, the more obvious frequency drift becomes. With a 40-meter VFO operating into a transmitter on, say, 7100 kc, a drift of one kc is relatively minor. However, using a VHF VFO with a fundamental frequency of, for example, 8100 kc, a deviation of one kc becomes 18 kc when it gets up to 145.8 mc, since the fundamental frequency is multiplied 18 times.

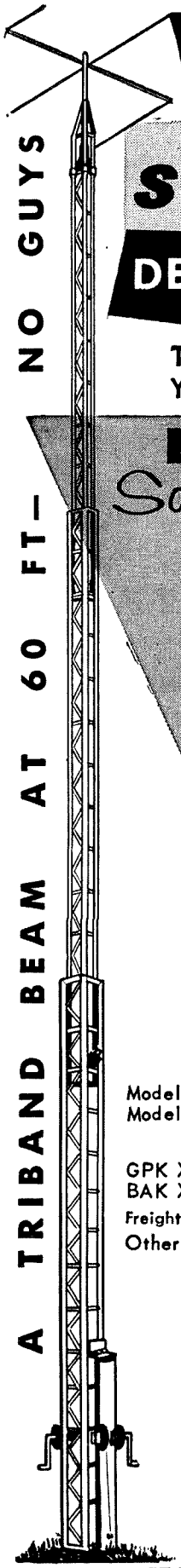
Variations in VFO tube plate and screen-grid voltage and temperature changes of the tuned circuit are the major causes of VFO drift, as most of us know. Shock and vibration are secondary causes. Separate the heat-generating components from the tuned circuit, and control the plate and screen-grid voltages, and you normally have a stable VFO.

Remote-tuned VFO's are certainly nothing new, yet they have been largely ignored in VHF work. The VFO shown in the photographs and in Fig. 1 has been in use at W6TKA for well over a year. Drift is minimized by regulation of the 5763 screen voltage, and by allowing the VFO to run continuously. A relay (K-1) changes the frequency slightly, by placing a 15 mmfd silver mica capacitor from the 5763 cathode to ground during stand-by periods, to eliminate VFO interference with received signals. A crystal-controlled converter and communications receiver are used at this station, and the frequency shift obtained with this system is sufficient to put the VFO signal well out of the bandpass of the receiver.

Choice of VFO operating frequency is governed by the equipment with which the VFO will be used. In the illustrated case, the VFO is used with an ARC-4, which requires 6.0 mc crystals, so the VFO operates on 6.0 mc. With an SCR-522, the VFO should operate on 8.0 mc, and with a Gonset Communicator I or II on either 8.0 mc or 24 mc.

A slight modification will usually have to be made to the equipment with which the VFO is to be used. In the case of the ARC-4, the 6V6 crystal oscillator must be modified to a buffer stage, simply by eliminating the grid-cathode capacitors, grounding the cathode, and feeding the VFO output to the grid of the 6V6.

Initial calibration was made with a BC-221 frequency meter, with the VFO and all transmitter stages operating. The 6.0 mc output was checked with the BC-221 (it goes only as high as 18.0 mc) and the various points marked on the dial, as shown in the photograph. You'll note from the photo that the VFO goes



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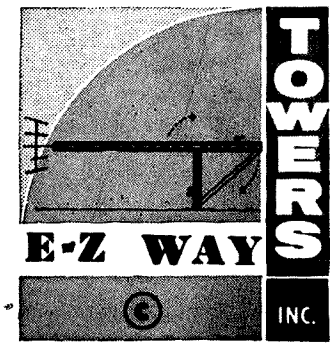
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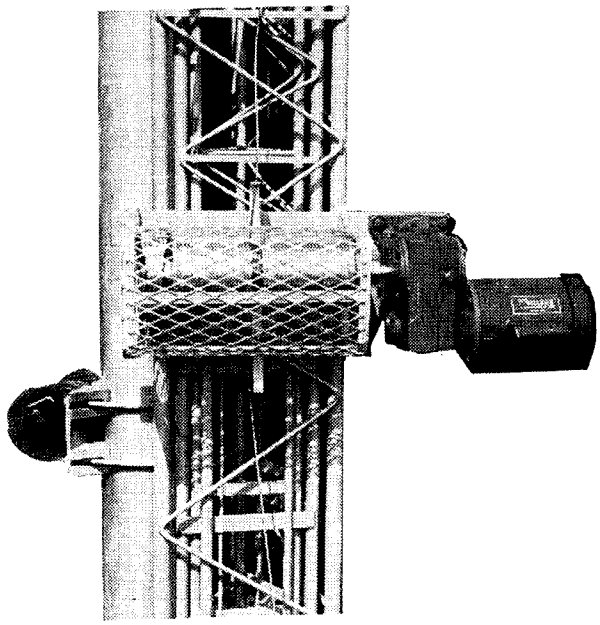
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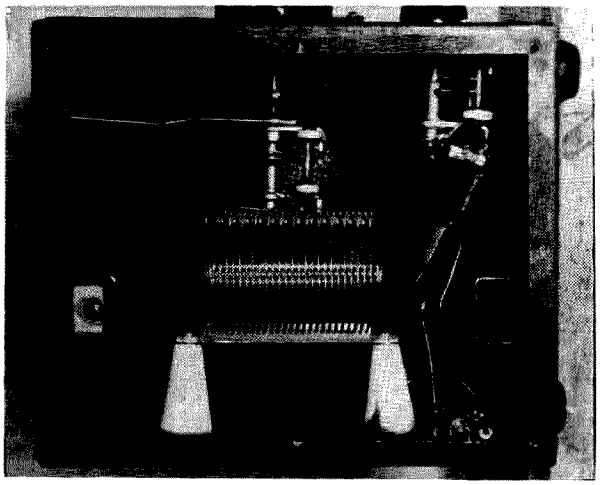
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only to 147.84 mc, but it could go higher with proper adjustment of the main tuning capacitor. Since I seldom operate above 147.5 mc, this shortcoming doesn't bother me; if it bothers you, you can easily fix it by moving the stator plate of the main tuning capacitor closer to the rotor plate. The entire two meter band can, by careful adjustment, be covered.

The dial is a National ACN, and the larger letters (the smaller type is hand-lettered) are from the "Artist Aid" sheets sold by many art supply stores, and is in this case 10-point Futura Demi-bold. The numbers are simply cut out and applied, which is much easier and neater than hand lettering. The original ACN dial card was discarded in favor of a thin sheet of matte-surface acetate, which takes both India ink and pencil nicely, making it ideal for marking net frequencies and such.

It is possible to install within the transmitter a switching arrangement to allow the choice of either VFO or crystal control. Being lazy, I chose to arrange to use the VFO also as a crystal oscillator, having already converted the ARC-4 crystal oscillator into a buffer stage. A crystal adapter was built using a two-crystal phenolic socket, pins from a discarded 6V6, and a couple of capacitors. The adapter is shown in the schematic and in the foreground of the photo of the complete unit. The remote-tuning unit is simply unplugged from the oscillator chassis, and the crystal adapter inserted, with the crystal in the adapter.

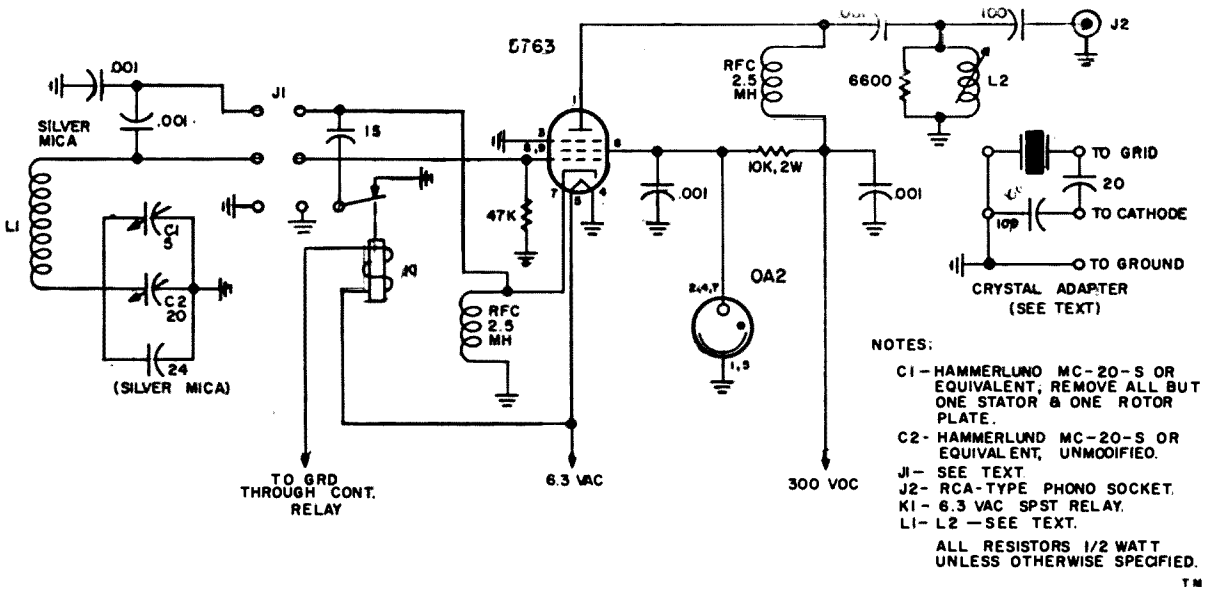
The schematic of the VFO is shown in Fig. 1. You will note that twin-axial cable—RG-22/U—is used instead of two lengths of conventional coaxial cable, due to less capacity to ground from the shielded conductors of the RG-22/U.

Although it would probably be better to regulate both the plate and screen of the 5763, I have regulated only the screen, and have had no indications of frequency change due to voltage fluctuations. I use an entirely separate power supply for the VFO, which I believe helps the voltage regulation.

A 6800-ohm resistor is placed across L2, in an effort to "broadband" the coil, and, since there is more output than necessary to drive the ARC-4, it also acts as a swamping resistor. The coil (L-2) is one removed from the receiver section of the ARC-4, and consists of 25 turns of #26 enameled wire, on a 5/16 in. ceramic, slug-tuned form. If a suitable ready-made coil is not available, a Millen #69041 can be used as the coil form.

Although the oscillator circuit was built in and on a 4" by 2¾" by 2" Minibox, as shown in the photograph, we would recommend use of a 5" by 4" by 3" Minibox, to allow more room for the components, especially the relay, which was added after the design and original construction were completed.

You will note that no provisions have been



made for keying the VFO. This can be done, if you must operate CW on two meters in this manner, by placing a keying jack in the cathode of the 5763; it is not recommended, however.

The tuned circuit is built in a surplus radio equipment box, from what equipment I do not remember, and measures 10½" by 6½" by 8½". Metal utility boxes measuring 10" by 8" by 7" are readily available at low cost, if a suitable box is not at hand.

The VFO coil, L-1, is an Illumitronic Air-Dux type 1609A. The coil is manufactured with a lucite mounting strip attached. For 6.0 mc operation the entire coil is used; for 8.0 mc only 18 of the turns should be used. The coil is mounted on E. F. Johnson Co. #135-501 steatite cone insulators.

The tuned circuit twin-ax plugs into the oscillator chassis by means of a crystal socket modified for use as a plug, and a pin-type jack for the shield connection. A standard crystal socket is mounted on the oscillator chassis, as is a pin-type jack. The shield of the twin-ax is soldered to the metal plate of the crystal holder. A much neater arrangement would be the use of a three-conductor socket and plug.

The output of the VFO is fed to the transmitter through a short (the shorter the better) length of RG-59/U. I found that it was necessary to detune the output coil (L-2) slightly so that it did not over-drive the 6V6 buffer (formerly crystal oscillator) stage of the ARC-4. This, however, might not be a problem with all transmitters with which the VFO will be used.

A final word of caution: be sure to place the tuned circuit box away from *all* heat generating components and equipment, and away from all sources of vibration and shock. Observe these precautions, and the construction methods used, and we predict that you, too, will have a stable VFO for two-meter use.

. . . W6TKA

Modifying the Sixer

THAT powerful little five watter that has made six meters so very popular with everyone, can be modified very easily and cheaply for a 50% power increase, simply by changing the output tube, the 6AU8 to a 6CX8, however there is a bite to it. In addition it becomes necessary to remove and replace three resistors, one capacitor, and slightly modify the oscillator coil. It requires about thirty minutes work for the average ham, more or less.

Remove both the grid resistors from the final, that is the 10K from pin 1 to ground, and the 22K from pin 7 to ground. Also remove the 4.7 mmf between pin 3 and pin 7, this is the coupling condenser between the triode plate and the pentode grid. Also remove the 22K 2 watt resistor from the screen grid circuit (pin 8 to lug 2 on terminal strip G). Now you are ready to insert the new parts.

Connect a 47K ½ watt resistor from pin 1 to ground; and a 47K ½ watt from pin 7 to ground. Now connect a 10K 2 watt resistor from pin 8 to lug 2 on terminal strip G. Next solder in a 25 mmf ceramic from pin 3 to pin 7. Always keep all leads short as passible but giving sufficient clearance for all parts.

The final step is the most complicated of all and care must be exercised. Either remove two turns from the oscillator coil (L201); or short out one turn at each end of this coil by carefully scraping the insulation from the wire one turn down on the coil from each end for a space of about 1/16 inch, just enough to get a good tin on the wire. Be very careful not to disturb any other insulation or more than is necessary. Now solder in a short wire from the solder lug on each end of the coil form to the nearest spot where you have scraped off the insulation at the end of the first turn of wire down from the lug on the coil form. This has shorted out one turn of the coil at each end. BUT *don't* do both and remove two turns and short out two. The latter method is given for those who might wish to put the set back in its original condition. All of the modification to the oscillator coil can be done without removing the coil form from the chassis.

The reason for modifying the oscillator coil is that with a 6CX8 in the final socket, it will not tune above something around 45 or 46 mc, due to the increase in capacity of the 6CX8 over that of the 6AU8; but after modification of the oscillator coil it will easily tune to 50 mc with the slug set about midway in the coil form.

As a final step, insert the 6CX8 in the final socket, and re-tune the transmitter circuits in the same method as described in the kit manual. The approximately 50% increase in power is well worth the time, effort, and small costs involved.

. . . K4ZQQ

Modifying the Lafayette HE-45

Larry Levy WA2INM

THERE ARE SO MANY good features on the HE-45 that it is hard to find anything to modify on it. The design is different from most transceivers in this price class with the result being that the usual modifications that I would make on a transceiver are unnecessary. The transmitter uses 8 mc crystals and the 2E26 final has more than ample power. The receiver is a single conversion superhet having one rf and two *if* stages. The sensitivity and selectivity are almost communications quality (the sensitivity is better than 1 microvolt and the selectivity is 3 kc at 6 db). It has an S meter, which also measures the plate current of the final amplifier. It has full PTT, a selector switch that allows you to choose any of five crystals or a vfo, and a spot switch. The 12 volt mobile supply is built inside the case, making it a complete station for use at home or in the car.

There are a couple of minor improvements which will make operation easier. The first of these is the addition of a non-spring return transmit switch. The spring return transmit switch seems to be a holdover from the original CB model of this transceiver, and on the citizens band, transmission should be as short as possible and it is unnecessary to have a fixed switch. This sometimes does make a long transmission on the ham bands somewhat uncomfortable because of the rather healthy spring used to spring-load the PTT switch on the microphone. This situation is easily corrected by mounting a SPST toggle switch somewhere on the panel and connecting it to pins 1 and 2 on the microphone jack. This will make the rig easier to operate and you will still be able to use the momentary PTT if you should so desire.

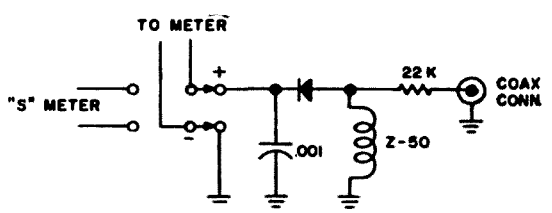


FIG 1

It is sometimes necessary to close-talk the microphone to get a high modulation percentage, especially if you normally speak quietly. This situation can be corrected by making the following changes: 1. Replace the 56K resistor in the plate circuit of V4-B with a 330K resistor. 2. Break the lead between the cathode of V4B and ground and add a 500 ohm resistor in parallel with a .25 mfd between the cathode and ground. 3. Replace the 5.6K screen resistor of the 2E26 with a 27k 2 watt resistor. These changes will considerably improve the modulation as well as eliminating a slight amount of instability in the final.

The dip on the final plate current is so slight that it is hard to tell when maximum output is reached when loading up some antennas. It is easy to change the metering circuit to one that measures rf output. To do this, first remove the white and the unshielded blue leads from the .51 ohm shunt resistor. The white lead is grounded. The blue lead is connected to the detector circuit shown in Fig. 1. The transmitter is then tuned for maximum deflection of the meter. A few of the HE-45 receivers have a tendency to drift during the first few minutes of operation. To correct this, replace the condensers that are connected to the oscillator coil as well as the one used for coupling to the mixer with new NPO condensers of the same value.

While these modifications were written for the HE-45, they can also be used on the 10 meter version (HE-50) or the CB unit as well.

. . . WA2INM

73 Tests the

Irving Hiverter 50

Sideband is a real comer on six meters and you seldom lack for a contact on SSB these days. As more and more converting transmitters and complete sideband rigs become available commercially it is obvious that sideband will become as popular on six meters as it has on the lower frequencies for it gives the same benefits. You can work out over much greater distances per given watt of input . . . it is simpler to build high power output stages when you don't have to worry about getting all that plate modulation power together . . . there is much less QRM, which has become quite a problem on six lately . . . and you can work through aurora with it.

A new piece of gear on the VHF market today is the Irving Electronics Hiverter 50. The Hiverter will convert any twenty meter AM, CW or SSB exciter into an efficient six meter transmitter with no trouble at all. A small company has to be especially careful of the quality of their product, or pfft goes its entire income. "Pappy" Irving has been scruplously careful with his products, and believe me . . . it shows on the Hiverter 50.

The unit can be used with any transmitter that is capable of producing from 10 to 100 watts of 14 mc rf. About six watts are needed to drive the unit, so transmitters with more than a twenty watt maximum must have some sort of carrier insertion control or attenuating device between their output and the Hiverter input. The instruction manual has a number of diagrams for simple resistive pads in case the user finds he has no way to control his driving transmitter output. With twenty watts input, the Hiverter will deliver 20 watts on AM, 35 watts on CW and 30 watts pep on SSB.

There are no unusual circuits involved in the Hiverter; a 6CL6 functions as a grid-plate harmonic oscillator, and uses an 18 mc crystal that doubles in its output section. So, if the twenty meter exciter is operating at 14.2 mc, the six meter output from the Hiverter will be 14.2 plus 36 which equals 50.2 mc.

The output of the harmonic oscillator is capacity coupled to the cathode of the 5763 mixer. The output of the mixer is tuned to the sum frequency of the Hiverter oscillator and the 20 meter exciter to produce output in the 50 mc range.

The amplifier circuit uses a 6146 that operates class AB1 or AB2. An rf choke and a capacitor form a series resonant circuit at 14 mc to eliminate the chances of having a 14 mc signal appear at the output of the Hiverter. The amplifier output tunes through a pi network, so any antenna with 50 to 100 ohm impedance should work out just dandy.

The internal wiring is all done on printed circuits, and everything is easily accessible for maintenance. The only maintenance that the user will be running into will be the periodic tube checks that are recommended in the manual.

An external power supply is needed to power the Hiverter, and most modern transmitters should be able to provide the voltages required. Four voltages are needed: 6.3 vac, 600 vdc, 300 vdc, and −130 vdc for bias. If the driving transmitter can't supply these voltages, a supply such as the Heath HP20 can be used or a supply can easily be built.

Tuning up is pretty simple with only three controls: mixer, amplifier, and antenna. Of course the driving transmitter must be pretuned on twenty meters before its output is fed into the Hiverter.

We drove the Hiverter on all three modes with a 200-V that was adjusted to produce 20 watts of rf on 14 mc. We got the maximum output claimed for the unit with no trouble at all. On SSB, the output, measured with a Gavin bridge was thirty watts on voice peaks. We also got the full 35 watts on CW, and 20 watts on AM. In the course of testing the unit many stations were worked on all three modes on six meters. All the reports we got ranged from five by sixes to five by nines. Modulation reports were excellent. We experienced no trouble at all even when we overloaded the Hiverter input for short periods.

The Hiverter 50 is a heckuva lot of fun to use, and it is a simple way to get a good SSB signal on six without having to buy a mess of new equipment. The Hiverter should make quite a Christmas present . . . it's inexpensive ($99.50 complete), efficient, and fun to hook up and use. We sure enjoyed it.

73 Staff.

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Aikens Electronics Sup., Inc.
531 Broad Street
DeMambro Radio
334 Broad Street
STAMFORD
Radio Shack
High Ridge Rd.
WATERBURY
Bond Radio
439 West Main Street
WEST HAVEN
Aikens Electronics Supply
670 Orange Street
WEST HARTFORD
Radio Shack
39 South Main Street
WESTPORT
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Post Road

DISTRICT OF COLUMBIA
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2345 Sherman Avenue, N.W.

FLORIDA
MIAMI
Electronic Wholesalers, Inc.
9390 N.W. 27th Avenue
ORLANDO
Amateur Electronic Supply
23 Azalea Park Shop. Ctr.
TAMPA
Kinkade Radio Supply, Inc.
1719 Grand Central Avenue

MAINE
AUBURN
Radio Supply Co.
28 Cross Street
BANGOR
Radio Service Lab.
23 Palm Street
PORTLAND
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1004 Congress Street

MARYLAND
BALTIMORE
Amateur Radio Center
2203 N. Fulton Avenue
SALISBURY
Standard Electronics Co., Inc.
301 Snow Hill Road
TOWSON
Baynesville Electronics
1631 E. Joppa Road
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11324 Fern Avenue

MASSACHUSETTS
BOSTON
Cramer Electronics
811 Boylston Street
DeMambro Radio Supply Co.
1095 Commonwealth Avenue
Lafayette Radio
110 Federal Street
Radio Shack
730 Commonwealth Avenue
BRAINTREE
Radio Shack
Shopping Center
BROCKTON
DeMambro Radio
1839 Main Street
BUZZARDS BAY
Buzzards Bay Electronics
196 Main Street
FALL RIVER
Haddad Electronics
121 Pine Street
HAVERHILL
Valley Electronics
201 Winter Street
HYANNIS
DeMambro Radio
223 Barnstable Road
LAWRENCE
Alco Electronics
3 Wolcott Street
DeMambro Radio
194 Broadway
LEOMINSTER
DeMambro Radio
760 South Main Street
NEW BEDFORD
E. A. Ross Co.
1663 Purchase Street
MEDFORD
DeMambro Radio
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N. WESTPORT
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READING
Graham Radio
505 Main Street
SALEM
DeMambro Radio
280 Highland Avenue
SAUGUS
Radio Shack
Shopping Plaza
SPRINGFIELD
DeMambro Radio
269 Spring Street
WORCESTER
Radio Maintenance
80 Thomas St.
DeMambro Radio
222 Summer Street

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CONCORD
Evans Radio, Inc.
P. O. Box 312
DOVER
DeMambro Radio
3 Hale Street
KEENE
DeMambro Radio
300 West Street
MANCHESTER
DeMambro Radio
1308 Elm Street
PORTSMOUTH
Rockingham Electric
377 Court Street

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CAMDEN
Radio Electric Service Co.
513 Cooper Street
MOUNTAINSIDE
Federated Purchases, Inc.
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PARAMUS
Lafayette Radio
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PATERSON
National Electronics
226—17th Avenue
UNION CITY
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2812 Hudson Boulevard

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Fort Orange Radio Dist. Co.
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AMSTERDAM
Adirondack Radio
185 West Main Street
BUFFALO
Genesee Radio & Parts Co.
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Winchell Electronics
65-67 Clinton Avenue
ELMIRA
Chemung Electronics, Inc.
403 E. Third Street
FREDONIA
Barker Higbee, Inc.
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JAMAICA
Harrison Radio
144-24 Hillside Avenue
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CHARLOTTE
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ASHTABULA
Morrison's Radio Supply
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CINCINNATI
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633 Walnut Street
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TEXARKANA
Lavender Radio & TV Sup. Co.
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COLORADO
DENVER
Radio Products Sales Co.
1237—16th Street

ILLINOIS
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Allied Radio Corp.
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Amateur Electronic Supply
6450 N. Milwaukee Avenue
Green Mill Radio Supply Co.
145 West 111th Street
Newark Electronics Corp.
223 W. Madison Street
MOLINE
Lofgren Distributing Co.
1212 Fourth Avenue
PEORIA
Klaus Radio & Electric Co.
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Selectronics Supplies, Inc.
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H & H Electronic Supply, Inc.
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Northwest Distributing Co.
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Castrup's Radio Supplies
1014 W. Franklin Street
INDIANAPOLIS
Graham Electronic Supply, Inc.
122 S. Senate Avenue
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COUNCIL BLUFFS
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R. R. #2

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SALINA
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Tel-Rad Electronics, Inc.
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Crescent Electronic Supply
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Ports Electronic Parts Co.
2423 Southern Avenue

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ANN ARBOR
Purchase Radio
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DETROIT
M. N. Duffy & Co.
2040 Grand River W.
Radio Supply & Engr. Co.
90 Selden
Reno Radio Company
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FLINT
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Warren Radio Company
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Northwest Radio of Michigan
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MUSKEGON
Electronic Distributors, Inc.
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DULUTH
Northwest Radio of Duluth
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Lew Bonn Company
1211 La Salle Avenue
Electronic Center
107—3rd Avenue

MISSOURI
BUTLER
Henry Radio
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JOPLIN
Norman Electronics
402 Wall Street
KANSAS CITY
Burstein-Applebee Co.
1012-14 McGee Street
ST. LOUIS
Walter Ashe Radio Co.
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MINOT
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216 Second Street, S.W.

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Reynolds Radio Supply Co.
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OKLAHOMA CITY
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TULSA
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AMARILLO
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Gilbert Company
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Manwill Supply Co.
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LA CROSSE
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Chester Electronic Supply Co.
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Henry Radio
11240 W. Olympic Blvd.
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Selectronics
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SAN CARLOS
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15 Mount Royal Blvd.

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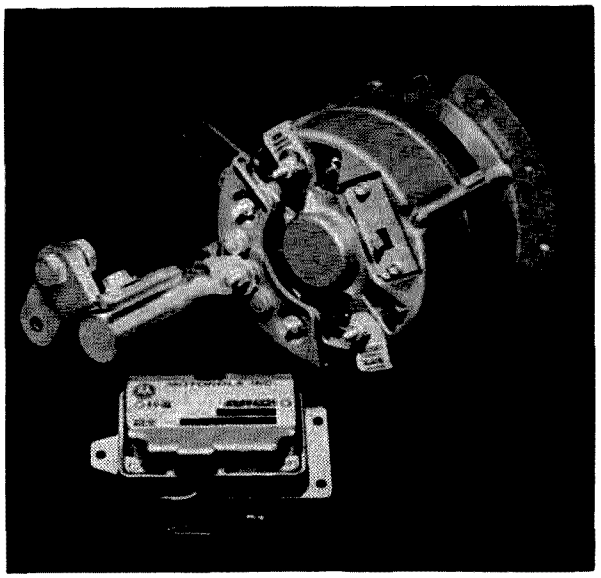
NOVA SCOTIA
HALIFAX
Consolidated Supply Co., Ltd.
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ONTARIO
DOWNSVIEW
Alpha-Aracon Radio Co., Ltd.
555 Wilson Avenue
FORT WILLIAM
Lee-Bern & Company Ltd.
105 Simpson Street
HAMILTON
Crawford Radio
119 John Street N.
LONDON
C. M. Peterson Company, Ltd.
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Niagara TV Supply Co.
1525 Main Street
NORTH BAY
Johnson Electric Supply Co.
135 McIntyre Street, East
TORONTO
Electro-Sonic Supply Co., Ltd.
543 Yonge Street

QUEBEC
MONTREAL
Electronic Tube Co., Ltd.
464 McGill Street
Payette Radio Co., Ltd.
730 St. James Street, W.

SASKATCHEWAN
SASKATOON
Radio Supply Co., Ltd.
561 Second Street

Tom Lamb K8ERV
1066 Larchwood Rd.
Mansfield, Ohio

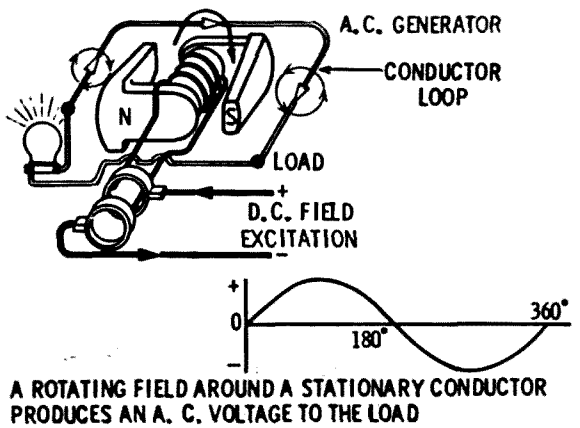


A New Look at The Alternator

THE ADVANTAGES of the alternator are not new to most mobile amateurs. Unfortunately their high cost usually limits their use to those who can obtain used machines from trucking companies, or from the police.

Motorola is now making all electronic 30 and 45 amp alternator systems that are ideal for amateur use. This new equipment is light, compact, easy to install, and costs only about one dollar per amp! The solid state regulator eliminates all regulator noise.

One of the major problems with the conventional dc generator is its complete lack of output at idle. While plenty of power may be produced at highway speeds, the average output in city driving is very marginal, and completely inadequate to support that new 100 watt mobile rig! Let's look at the reasons for this performance.



A ROTATING FIELD AROUND A STATIONARY CONDUCTOR PRODUCES AN A. C. VOLTAGE TO THE LOAD

Fig. 1

All common generators generate a no-load voltage that is directly proportional to the rotor's speed. To obtain a given voltage at a very low speed requires that the rotor have a large diameter and contain many turns of wire. But many turns of (fine) wire will not produce high output current, and a large rotor may spin the wire out of the rotor slots at high speeds. The practical speed range of a dc automotive generator is limited to about 1400-12000 rpm. The pulley ratio must of course be set for the high speed limitations, giving insufficient speed at engine idle.

Now let's see how the alternator overcomes these speed limitations. Since no internal commutator is needed in an alternator, the machine can be built "inside out." That is, the field is placed on the rotor, and the load winding (armature) is on the outer shell, or stator. Fig. 1 illustrates this rotating field construction. Notice first that a *single* light field coil is

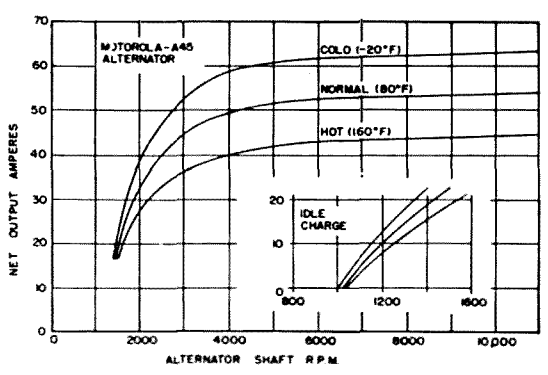


FIG 2

wound around the shaft, not along it, and thus cannot spin off at high speeds. This single change allows the alternator to spin much faster than the generator, allowing it to produce more power at low *engine* speeds. The Motorola units will generate 5-20 amps at idle, and full power by 20 mph! (See Fig. 2.)

The rotating field construction provides other features. The rotor has only two soldered connections, compared to 28 in a generator. The three amp maximum field current can be carried by very small slip-rings and brushes, reducing the unit's size. The load current does not pass through any moving contacts. These features plus good dynamic rotor balance should give the alternator long care free life.

Regulation

Both systems use an external regulator to keep the output voltage constant and to provide system protection against overload. The generator's regulator has three relays: a cut-out relay to prevent the battery from discharging back through the generator when the motor is stopped, an over current relay to protect the generator, and a voltage sensing relay to prevent system over voltage. While this mechanical equipment works fairly well, its vibrating relay contacts cause a high-frequency hash that is discouragingly difficult to filter.

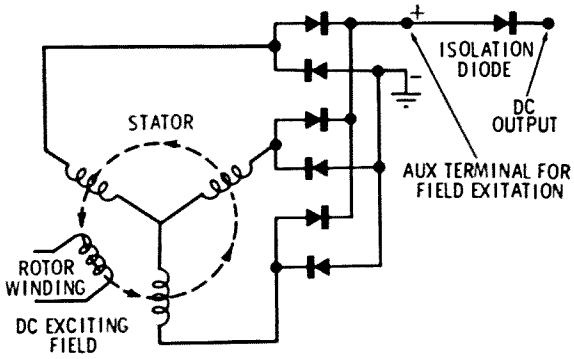


Fig. 3

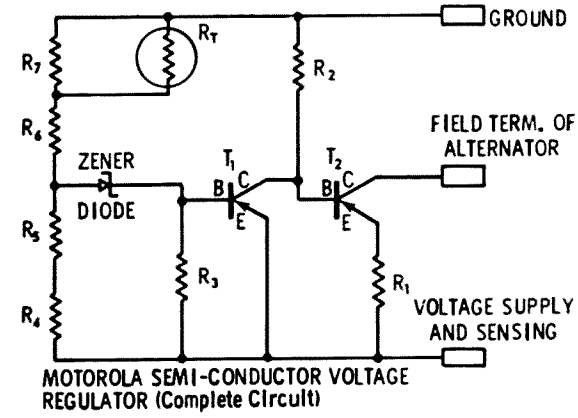
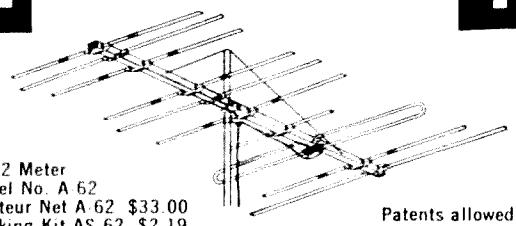


Fig. 4

2 ANTENNAS IN 1



6 & 2 Meter
Model No. A 62
Amateur Net A-62 $33.00
Stacking Kit AS-62 $2.19

Patents allowed and pending

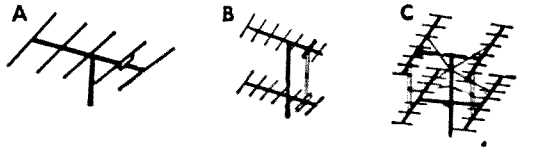
The Only Single Feed Line
6 and 2 METER
COMBINATION YAGI ANTENNA
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18 Elements
1 — Folded Dipole Plus Special Phasing Stub
1 — 3 Element Colinear Reflector
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ON 6 METERS
Full 4 Elements
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CUSHCRAFT VHF BEAMS
SINGLE • DUALS • QUADS



BEAMS (A)		Model No.	Ham Net
3/4 Meter	11 element	A430-11	$ 7.75
1 1/4 Meter	11 element	A220-11	9.95
2 Meter	7 element	A144-7	8.85
2 Meter	11 element	A144-11	12.75
6 Meter	3 element	A50-3	13.95
6 Meter	5 element	A50-5	19.50
6 Meter	6 element	A50-6	32.50
6 Meter	10 element	A50-10	49.50
DUAL STACKS (B)			
3/4 Meter	22 element	A430-11 D	18.50
1 1/4 Meter	22 element	A220-11 D	22.90
2 Meter	14 element	A144-7 D	21.25
2 Meter	22 element	A144-11 D	29.00
QUADS (C)			
3/4 Meter	44 element	A430-11 Q	43.00
1 1/4 Meter	44 element	A220-11 Q	54.50
2 Meter	28 element	A144-7 Q	62.50
2 Meter	44 element	A144-11 Q	76.00

See your distributor or write for complete Catalog No. 116



Cush Craft 621 Hayward Street Manchester N H
A FULL LINE OF • AMATEUR COMMUNICATION ANTENNAS

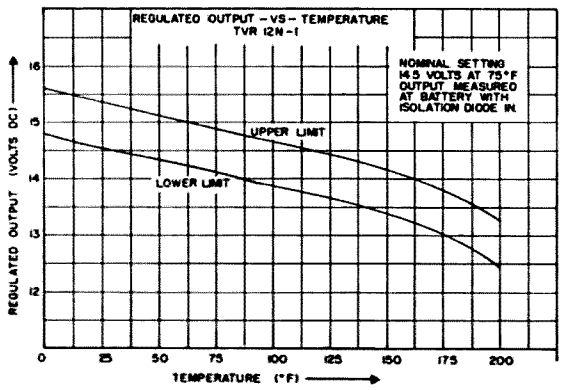


FIG 5

The Motorola system uses a solid-state regulator—no contacts, no hash! No reverse current cut-out relay is needed, the rectifying and isolation diodes takes its place (Fig. 3). Nor is an over-current relay used. Fig. 2 shows the alternator to be self limiting at high speeds. This is due mainly to an effect called "armature reaction." As the output current increases it produces a reaction field that counteracts the rotating field, leveling off the output. (The temperature effect in Fig. 2 is due to the change in coil resistance with temperature).

This leaves only the output voltage to be regulated. Fig. 4 shows the regulator circuit. When the output exceeds the present level (about 14.5 V) the 10 volt Zener diode conducts. A highly amplified current decreases the field current, restoring the proper output. The circuit is so good that the system voltage varies only .1 volt from 10 to 70 mph! A thermistor is used to match the regulator and battery characteristics over a wide temperature range, as shown in Fig. 5.

I have used this system in a Renault for six months, and consider it the most useful possible addition to a mobile installation.

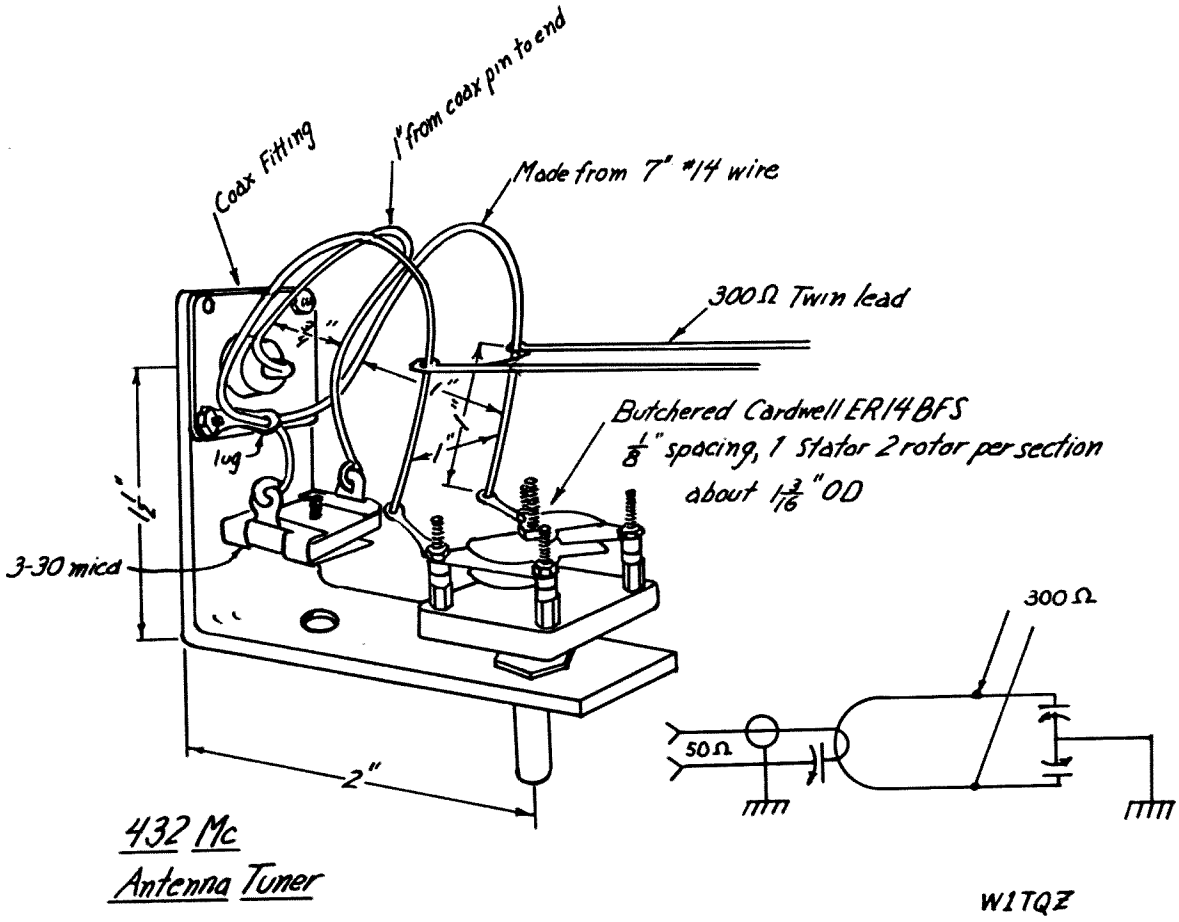
I am indebted to Motorola, Inc. for the technical information contained in this article.

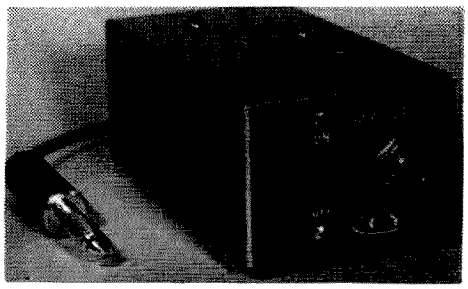
432 mc Antenna Tuner

Dear Wayne,

Took me a long time but I finally inked the drawing on the 432 mc Antenna Tuner. It works for me, showing almost unity SWR in the coax with a Jones Micromatch.

Francis LeBaron, W1TQZ





Clipper

The Chatterbox, made by C-Y Electronics, is a clever little gadget that connects between your mike and your rig and gives you a remarkably high percentage of modulation. This little transistorized clipper-filter gives you extra gain to make up for any deficiencies of your rig, increases the average percentage of modulation to give you much greater talk-power (punch), and keeps your signal within the 2.5 kc bandwidth best for communication. The gadget also works just fine with tape recorders, phone patches, and public address systems. $24.95. Write for poop-sheet and complete price list of different models. C-Y Electronics, 3810 East 365th, Willoughby, Ohio.

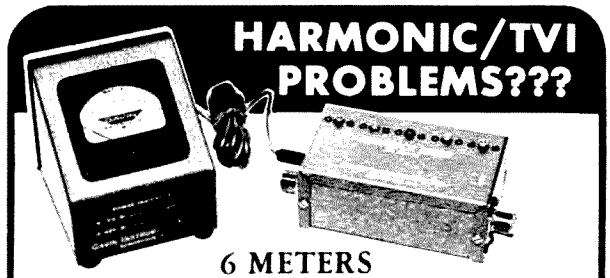
C-Y sent us one to try out in the HQ hamshack. The reports were very gratifying. We plugged it into every rig in the place and bothered everyone who would come back to us for a comparison. The universal result was that our signals had much greater punch with the Chatterbox in the circuit. It made quite a difference on marginal signals on two meters where fading and low signal strength often took us out of the picture without the Chatterbox. On twenty meters we just sounded a little louder than normal . . . as one chap said, "Now you sound like you are 50 db over 9 instead of 30!"

Letter

Wayne:

Why don't you pass along to the boys the fact that the spare strips in the hamshack TV can easily be modified to tune the FM band. Pull one turn off the oscillator coil for channel six and you've got it made. Just tune the slug to the proper position once. In this area we have five TV and seven FM stations, just right to fill a 12 position tuner.

Robert Tomich K7GYH



HARMONIC/TVI PROBLEMS???

6 METERS

TUNABLE LOW-PASS MAVERICK

The only low-pass filter designed expressly for 6 meters. With 9 individually shielded sections and 5 stages tunable forming a composit filter of unequaled performance. 1 DB loss. Handles 400 watts PI. 35 DB rejection. Size 5" by 2" by 3". *AMATEUR NET $16.95*

MAVERICK II WITH POWER MONITOR

Same as above but with 6 meter power indicator calibrated in watts output. Indicator Size 4" by 4" by 4½". Slant Face. Reads 0-50. 0-400 watts. *AMATEUR NET $34.95*

2 METERS

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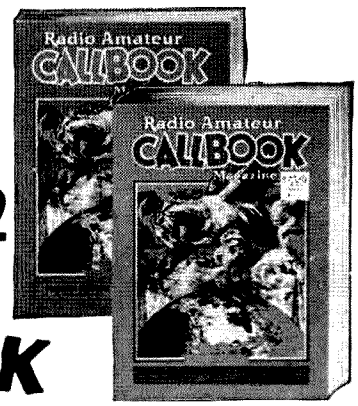
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HOW MANY TIMES have you said to yourself, "if only I had a tachometer on this car"! Never? That doesn't disturb me a bit. I am still going to tell you how to build this auto analyzer. You really NEED to know. It contains among other things a tachometer, dwell angle meter, engine wall temperature indicator, and battery voltmeter.

Sounds complicated doesn't it? It is. However, think of the satisfaction of saying to your garage mechanic, "I noticed a slight knock at 1300 RPM the other day." Or, "the dwell is two degrees off" (whatever that means).

The whole project was started to replace an 'idiot light' on my Corvair, and was ended when I created this Frankenstein's monster. I get quite a bit of enjoyment from it however. Seldom do I drive into a service station without someone saying, "what's that thing?" This gives me a chance to explain the theory behind the circuit, and generally gets me faster service, since they are so happy and grateful to learn just how the circuit works.

An added attraction is that it enables you to tune up your own engine. The only additional equipment required is a shop manual for your particular type auto, and a mechanic. But on to more important things.

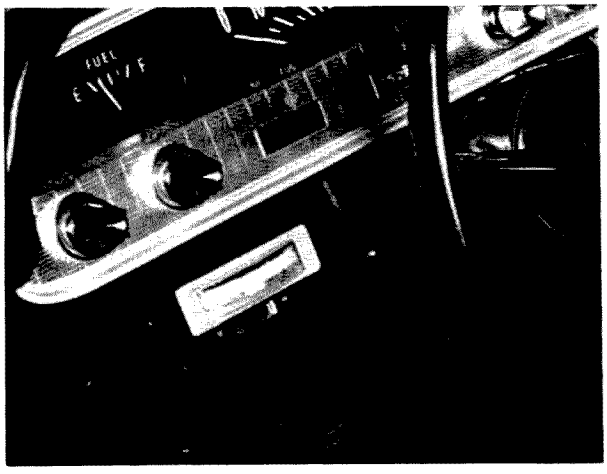


Fig. 1: Auto analyzer mounted in car.

There are four separate circuits in the auto analyzer. Any one or all four can be incorporated by the builder into his own unit. The tachometer is of course the most complicated circuit. Referring to the circuit diagram, notice that the tach input is tied to the high side of the points. This makes no noticeable difference in the operation of the engine, since the load applied by the circuit is very light. Resistor R1 and capacitor C1 form an integration network to integrate the pulses. (Along with all true southern boys, I am trying to find a segregation network to replace these integration networks and offer separate but equal facilities to all pulses, but I am unable to get a toe-hold on the problem as yet.)

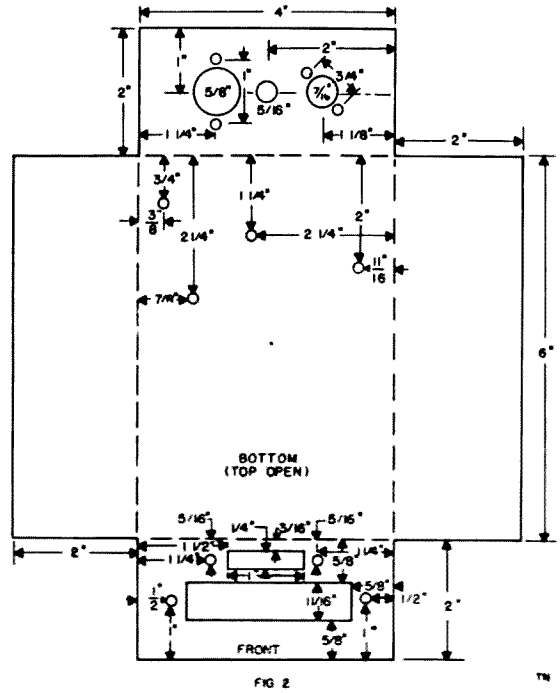


FIG 2

To continue, capacitor C2 feeds the now integrated positive pulses to the transistor network, which is actually a pulse counter disguised as a tachometer. Observe that Q2 is normally cut off by the Q1 collector current



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drop across R5, and the battery BA1. Q1 is normally drawing a collector current determined by the base bias supplied by the resistor R2. When a positive pulse arrives from the ignition points, Q1 is cut off, the voltage on the base of Q2 rises, and the meter reads the collect current of Q2. Capacitor C1 and C3 tend to average the pulses and cause the meter to read steady, instead of fluctuating wildly as you would expect.

Now, at 5000 RPM, the points of a 6 cylinder auto give out with a pulse repetition rate of 5000 divided by 60 times 3 per second. Th's figures out to be 250 pulses/second. With the proper value of C1 and R6, the meter reads full scale at this repetition rate. The zener diode D1 prevents battery voltage variations from affecting the meter reading.

The other functions of the analyzer are composed of much simpler ciriuits. The battery voltage is measured by an expanded scale voltmeter. This expansion is accomplished by utilizing the fact that an ordinary silicon diode will not conduct on less than 0.6 volt. A divider is constructed with R11 and R12, such that at 10 volts input to the circuit the voltage across the diode D2 is just 0.6 volt. The meter then reads from 10 volts to 15 volts over the entire scale. This function is not as convenient as a battery ammeter, but is some help in determining whether your generator is charging the battery.

The engine temperature measurement is actually a measurement of whether the engine wall temperature is normal. A conventional ohmmeter circuit is used, consisting of R10 (a thermistor or temperature-sensing resistor), R9 (the *normal* calibration resistor) and the meter. R10 is mounted on the engine wall and R9 is adjusted to center the meter in the normal zone, after the engine is warmed up.

The point dwell is measured by an even simpler circuit. It works by virtue of the fact that the meter will indicate the average condition of the point circuit (that is, whether the points are open or closed). The meter is connected to the high side of the points by a resistor (R8) sufficient to allow the meter to read fullscale when the points are open.

When the points are closed, the meter reads zero. The meter therefore reads the average open time of the points, and is calibrated in dwell angle, 60 degrees to 0 degrees.

Construction

In order to save space, the analyzer is built to mount under the dash of an automobile. A standard chassis is used, measuring 6X4X2 inches. The open side of the chassis is used as the top, and is mounted against the under-

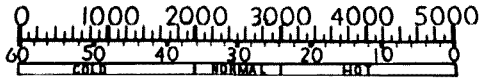


Fig. 3: Meter scale used on analyzer.

side of the dash, as shown in fig. 1. A special meter must be used to fit this type of construction. This type of meter is called an "edgewise" meter.

Begin the construction by punching the chassis as shown in Fig. 2. After punching the chassis, mount switch S1. Connect the strap and five wires, each 6 inches long to the proper lugs on the switch (see Fig. 7). The meter may now be mounted. Although a correction or read-out chart can be used with the meter, a proper scale is desirable. Fig. 3 shows the scale used on my analyzer. This will be correct for everything except an engine whose RPM will exceed 5000. A 10,000 RPM scale can be substituted in this case. Or you can make up a scale to fit your own requirements. Paste the new scale over the meter scale, using an epoxy resin cement. Other cements will buckle with moisture.

The most difficult part of the construction is the printed circuit used for the tachometer. If you do not have the means of etching such a board, or a friend who can do it, you can use the perforated phenolic board listed as an alternate in the parts list. If you use a perforated board, you must of course wire between the connections shown in Fig. 7 with hook-up wire. Use rivets or eyelets at the connection points, and put the hook-up wire on the back side of the board. When the wiring on the board is completed, mount the board behind the meter on ½ inch standoffs. If metal standoffs are used, be sure they do not ground any of the wiring. Mount BA1 beside the board.

Fig. 4 shows the completed analyzer. You will notice that there are connectors mounted on the back of the chassis for the input and battery cables. These are optional with the builder, and should only be used when it may be necessary to remove the analyzer frequently from the car. In permanent installations, rubber grommets can be used, and the cables connected directly to the analyzer.

Other components not included on the printed board are mounted on two terminal strips, one on each side of the unit. When these components are mounted, the wiring can be completed. Two 8-32 bolts are installed head down, one on either side of the chassis, extending upward. These bolts are used to mount the analyzer to the underside of the dash.

Three cables must be run to place the analyzer in operation. Two of these go to the engine, and the other connects to the battery fuse block, under the dash. Fig. 8 shows the method of running the engine cables to the

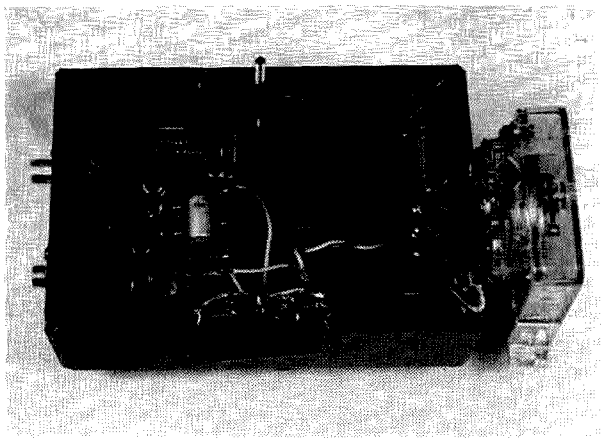


Fig. 4: Inside view of the analyzer.

rear; in this case on a Corvair. The first of these cables is a 15 foot piece of RG-58/U coaxial cable. Ground the shield at the analyzer end, and leave the shield unconnected at the other end. The center conductor of the coaxial cable connects to the high side of the ignition points (the low side of the coil) as in Fig. 9. The center conductor goes into the analyzer circuit as shown in Fig. 6.

The second cable to the engine can be any type of two conductor insulated wire, such as

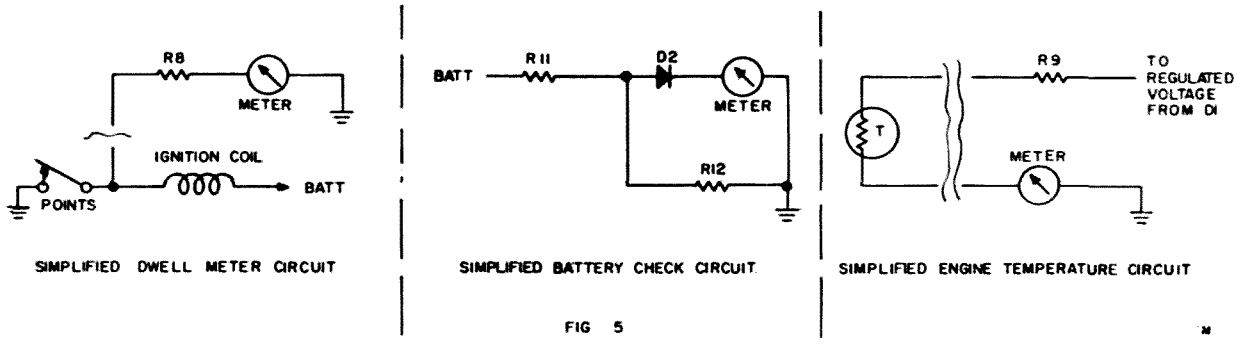


Fig. 5: Simplified schematic of the temperature, battery, and dwell meter circuits.

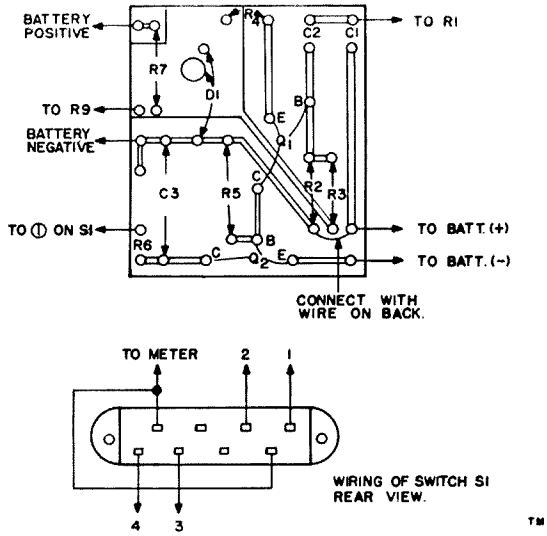


Fig. 7: Schematic drawing of printed circuit board and wiring on S1.

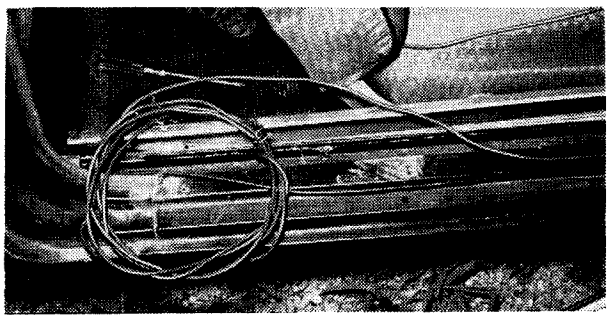


Fig. 8: Photo showing cables in channel to rear engine for tachometer and temperature circuits.

lamp cord. It connects to the thermistor which is mounted on the engine block. This thermistor is a small bead, about 1/16 inch in diameter, mounted in a slender glass tube, ⅛ inch in diameter and 1 inch long. To make it more rugged, and easier to handle and mount, put the thermistor in a brass or copper tube, and seal it in place with epoxy. Longer wires should be connected to the present thermistor wires. I used a brass tube ¼ inch in diameter and 2 inches long. A 3/16 inch hole was bored to mount the thermistor, and then the brass rod was clamped to the engine block.

The third cable supplies power to the instrument. One conductor supplies power to the analyzer, through the ignition switch, while the other conductor supplies power to the lamp in the unit, through the panel light switch. Fig. 10 illustrates the method of picking up these voltages from the fuse block. None of the cable lengths are critical.

Calibration

Refer to Fig. 5 and 6. First of all, the calibration methods will be given. Then conversion to 6 volts and positive grounds will be discussed.

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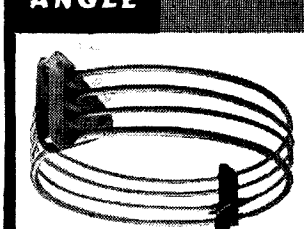
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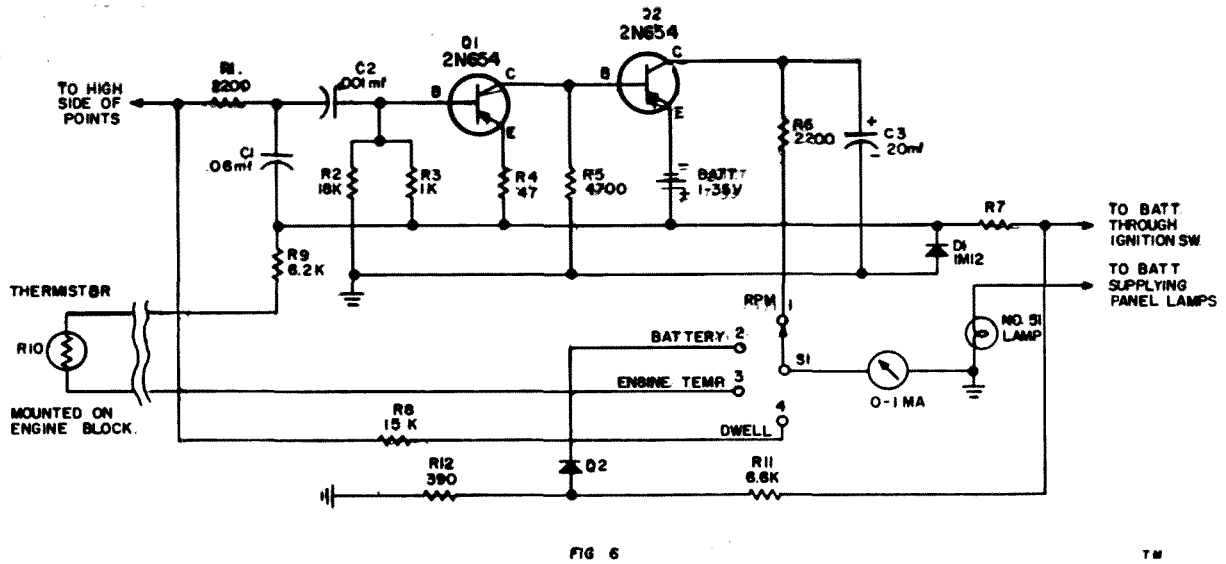


Fig. 6: Complete schematic of analyzer.

To calibrate the tachometer circuit, you must first understand how it operates. Connected to the points, it is a counting circuit, which counts every time the points close. On a 4 cycle 4 cylinder engine, the points operate twice for every engine revolution; 3 times for a 6 cylinder engine, and 4 times for an 8 cylinder engine. Remembering this fact, connect the input of the tachometer to a 60 cycle source such as the ac line. (If you use a common outlet there may be a shock hazard; use an isolation transformer.) Put a 0.02 mfd capacitor in each side of the connection. The ac line will supply 60 counts per second to the tachometer. This will correspond to 1800 RPM on a 4 cylinder engine, 1200 RPM on a 6 cylinder engine, and 900 RPM on an 8. Adjust R6 until the meter reads correctly.

To calibrate the temperature circuit, use the values shown on the schematic to begin. Operate the engine until it has reached normal temperature. Now adjust the value of R9 until the meter reads mid-scale. Color the HOT section of the meter scale red. An air-cooled engine will heat very quickly when the air flow is stopped or reduced. This indicator will change into the HOT zone rapidly if the engine overheats.

The same procedure is used with the battery circuit as with the temperature circuit. A voltmeter is placed on the battery as an aid to calibration. When the battery reads 12 volts, adjust R12 until the meter reads mid-scale as before.

The dwell meter circuit calibration is harder in that it is relative to the present condition of your points. If they are not new, either file them smooth or replace and then gap properly

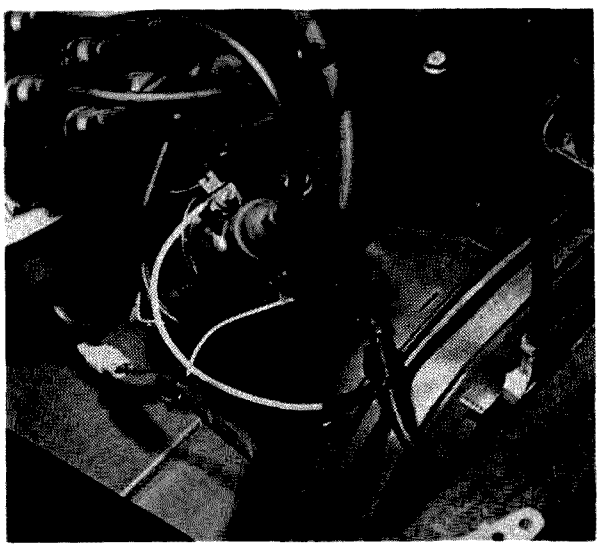


Fig. 9: Photo showing connection of RG-58/U to low side of coil.

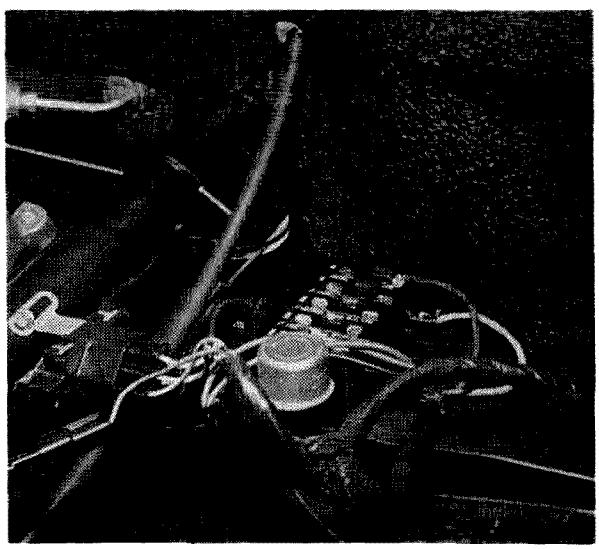


Fig. 10: Battery pickup on fuse block under dash.

with a gauge as you would normally do. Then adjust the value of R8 until the meter reads the correct dwell for your ignition system. From then on, the points condition is readily apparent by variations in the meter reading. You can get a much more accurate check on pitted points in this manner. The reading is not accurate, however, if the engine speed exceeds 1000 RPM.

Positive Ground Systems

On autos with positive grounds, the following changes must be made for proper operation. First, use 2N214 (NPN type) transistors in place of the 2N654. Reverse BA1; reverse D1 and D2; reverse the meter; and reverse C3.

6 Volt Operation

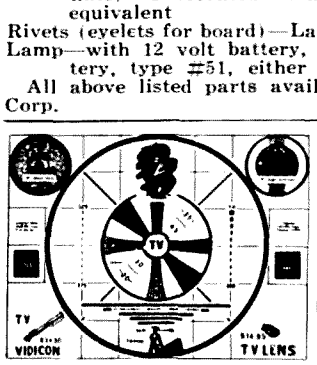
For 6 volt operation you must make these changes: first, eliminate D1 and R7; then change the resistor values as shown in the parts list.

. . . Henry

Parts List

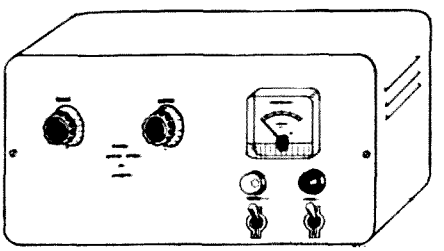
Wattage and voltage minimum.
C1—0.06 mfd, 600 wvdc, paper tubular
C2—0.001 mfd, 400 wvdc, ceramic
C3—20 mfd, 25 volt, electrolytic
R1—2200 ohms, ½ watt carbon resistor
R2—18 kilohm (12 volt battery); 10 kilohm (6 volt battery), ½ watt carbon
R3—1000 ohms, ½ watt carbon
R4—47 ohm, ½ watt
R5—4700 ohm (12 volt battery); 3900 ohm (6 volt battery), 1 watt carbon
R6—tachometer calibration resistor; 2200 ohm, 1 watt for 6 cylinder engine with 12 volt battery
R7—470 ohm, 2 watt carbon
R8—dwell calibration resistor; 15 kilohm, 1 watt for 6 cylinder engine with 12 volt battery and 33 degree normal dwell angle.
R9—temperature calibration resistor; with air cooled engine and 12 volt battery, 8.2 kilohm, 1 watt.
R10—thermistor, Glennite type 51PA1, 100 kilohm, bead in glass probe. Available from Lafayette Radio.
R11—6800 ohms (12 volt battery); 3900 ohms 6 volt battery), 1 watt.
R12—battery calibration resistor; 390 ohm, ½ watt for 12 volt battery.
S1—slide switch, 1 circuit 4 position, Lafayette stock #SW-74 or equivalent
M—1 milliampere meter, edgewise type, Lafayette stock #TM-21 or equivalent
D1—Zener diode, Motorola type 1M12, available from Lafayette Radio Corp.
D2—silicon diode type 1N536 or equivalent
Q1—2N654 transistor (negative ground); 2N214 (positive ground)
Q2—same as Q1
Chassis—Lafayette #MC-159 or equivalent
Printed board—Lafayette MS-519 or equivalent (alternate) Perforated board—Lafayette MS-304 or equivalent
Rivets (eyelets for board)—Lafayette MS-732 or equivalent
Lamp—with 12 volt battery, type #53; with 6 volt battery, type #51, either with socket.

All above listed parts available from Lafayette Radio Corp.



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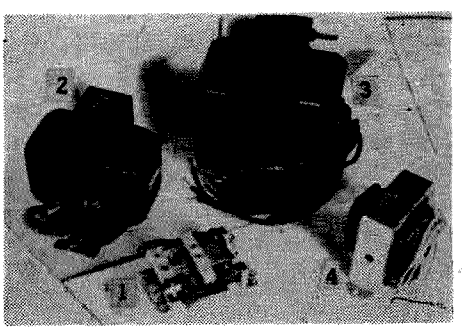
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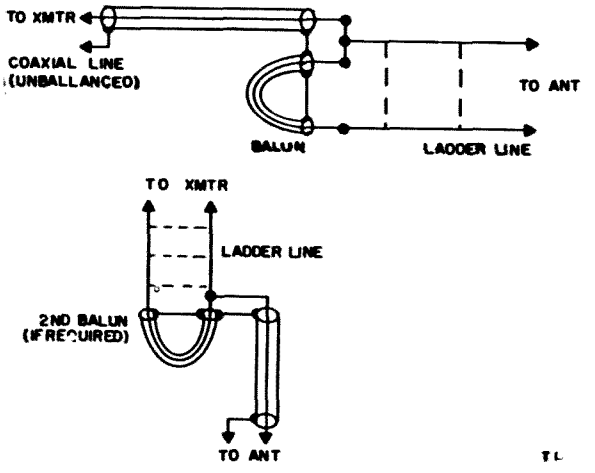
Antenna Relay, ceramic insulated, DPDT 15 Amp. contacts. 2" x 3" x 1¾". Specify coil voltage, 12V. dc, 6V. AC, 115V. AC. $2.50 (1)
RF Cable, 10' 3" long. RG-8/U with UG-21/U type N connector on each end. 4 lbs. $1.25 each, 10 for $10.00.
Audio output trans. 8000 ohms P-P to 4, 8, 16, 500 ohms. 15 watts. Good response to 15 Kc. 3" x 3½" x 3½". 4 lbs. $2.00. (2)
Power trans. 395-0-395V. 200 ma., 5V. 3A., 6.3V. 3.3A. 3¾" x 4½" x 4". 7 lbs. $4.00. (3)
6 BQ5/EL 84 tubes. Brand new, made in Germany. $1.00.
The following 2 items are made for us, to our specs.
Filament trans., 2 windings each 12.6V. 1 Amp. 2¼" x 2" x 2¾". 3 lbs. $1.95. (4)
Power trans. 125V. 20 ma., 6.3V. 0.6A. 1⅝" x 2⅞" x 1½". 1 pound. $1.50 (Looks similar to 4 above)
Please add ample postage, and in Ohio add 3% sales tax. Any excess is refunded.
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Coaxial Baluns

Larry Levy WA2INM

THE HIGH LOSSES of coax on the VHF and UHF frequencies make the use of open wire transmission line (ladder line) very practical and economical, especially considering the high cost-per-watt on 144 mc and the even higher cost-per-watt on 220 and 432 mc. Ordinary 300 ohm twinlead will work, but the tubular polyfoam is recommended. The lowest loss possible can be achieved by the use of ladder line. The loss of this line is very low compared to coax. At 2 meters, the loss of 100' of RG8/U is about 3½ db. The loss of 300 ohm ladder line is about ½ db for the same length. Translated into power, this means that about twice the power reaches the antenna with the ladder line. Losses on the other bands are proportional to the frequency. 300 ohm ladder line does not seem to be a standard item but it is available from Lafayette Radio. The cost for 100' is only $1.90 (Lafayette stock no. WR-125) which is so much more economical than RG8/U that it would pay to use it even if the losses were equal.

Most transmitters are designed to load into a 52 or 72 ohm unbalanced line (coax) and not into a 300 ohm balanced line. A coaxial half wave balun can be used to match the ladder line. The baluns have an impedance ratio of 4:1, so if 72 ohm coax is used, the resulting impedance will match the 300 ohm line quite well. The impedance can be changed back to 72 ohms by another balun connected in reverse at the antenna end of the line. This is necessary if the antenna is gamma matched, etc. If 52 ohm line is used, the resulting impedance is 200 ohms which will match 200 ohm twinlead (KT-200, etc.) or beams that are "T" matched.



By the use of ladder line and impedance matching baluns, the required impedance can be obtained with a substantially lower line loss than can be gotten with coax. Without investing any extra money in your rig, you can double your ERP on 2 meters (if you are using 100' of RG8/U) by just replacing the coax with ladder line. On the 432 mc band, RG8/U has a loss of approx. 6-8 db per hundred feet. The 300 ohm ladder line has a loss of less than 1½-2 db for 100' of line. This means that with RG8/U, only *15-25%* of the power reaches the other end of 100' of coax. With the ladder line, over 75% of the power reaches the antenna with the same length of line. On a band where there is a power limit of 50 watts, the power lost in the line is irreplaceable as it cannot be made up by increasing the input. Even if it could be replaced by increasing the input, power at this frequency is *expensive* to generate and the extra power could be put to much better use than heating a length of coax. The losses become important on the receiving end where there is a fixed amount of tube noise (as low as it is) and every bit of attenuation by the transmission line reduces the signal-to-noise ratio that much more. (The same amount of noise and less signal.) If a weak signal is received at the antenna, there is very little chance that it will be heard if coax is used because of the reduction of the useful signal-to-noise ratio.

If there is a situation where a 432 mc signal reaches the antenna at a level that is 4 or 5 db higher than the front end noise of the converter and 100' of RG8/U is used for the transmission line, the signal will not be heard (the signal will reach the converter 6-8 db weaker because of the line attenuation and will be 1-4 db below the noise). If ladder line is used (with a loss of less than 2 db), the signal will be out of the noise by 2 or 3 db. The example cited is far from uncommon and having a low loss transmission line will make the difference between no QSO and solid copy many times. The advantages are multiplied when low loss lines are used on both ends of a QSO.

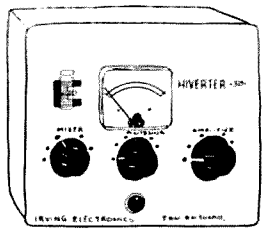
The lengths for the various bands are given below.

50Mc.—76" low end, 74½" high end
144Mc.—26½"
220Mc.—17½"
432Mc.—8⅞"

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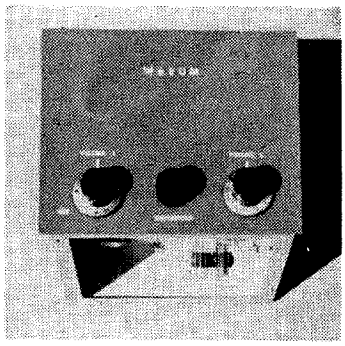
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Selectivity Plus

Don Wherry W6EUM
2121 Grand View Drive
Camarillo, California

WITH the addition to our ranks of hundreds of new amateurs each month the time is rapidly approaching, if in fact it is not already here, when it will be nearly impossible to carry on a conversation with anyone but those with the loudest signals. The only solution to that problem, it would seem, is to utilize either greater and greater receiver selectivity or some other spectrum saving device. SSB with its single sideband and reduced bandwidth characteristics has allowed our receiver selectivity to approach the optimum for fone, but let's look at the CW picture as it stands today.

A selectivity curve for a CW receiver could be obtained which would have a half power point (3db) of one to two hundred cycles. This bandwidth might be adequate, but let's examine such a situation. To obtain such selectivity the passband must be very sharply peaked, which presents a knife edge center frequency. This is great except for one small detail—no one could copy the code passing through because of the excessive "ringing" of the high Q circuits necessary. This means that the narrowest usable passband must be several hundred cycles wide at the 3db point to be even remotely usable, and even then the ringing presents a difficult and tiresome experience to the operator. This ringing has been alleviated to some degree in the flat top characteristic curves of the mechanical filters, and by the use of low frequency *if* strips, but again there is a limit to the narrowness of the passband which will allow a readily readable signal to pass. It becomes obvious, therefore, that some new approach is necessary if we are going to improve our lot—which brings us to the subject of this article.

Several years ago a method of improving our CW reception was presented which utilized

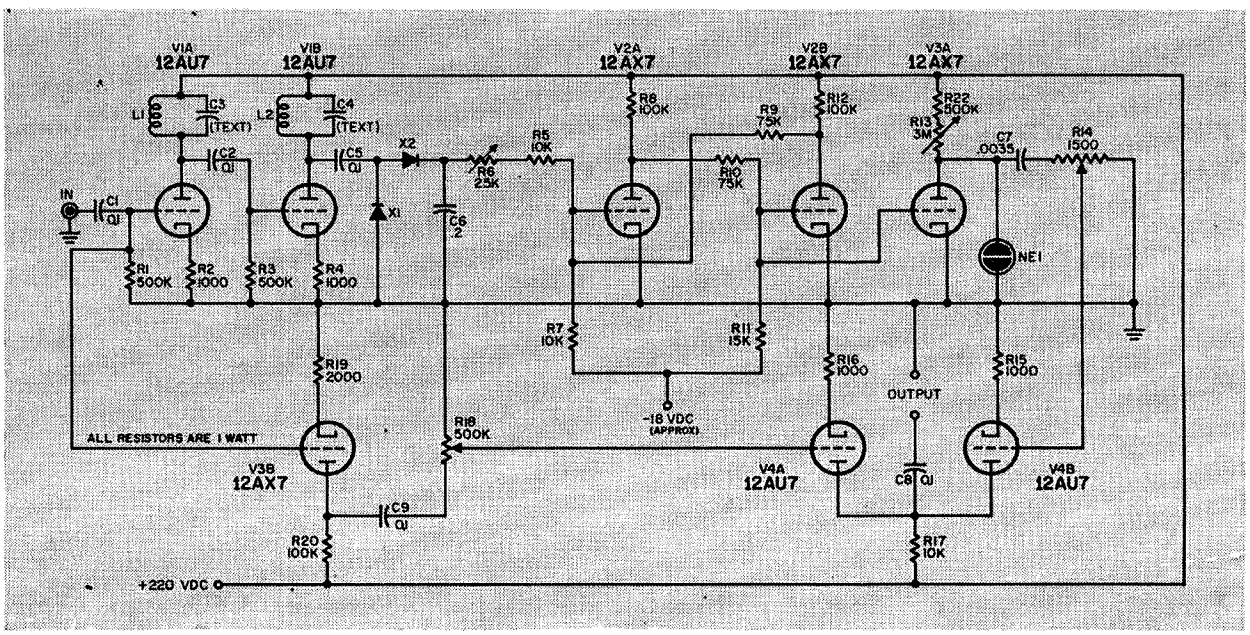
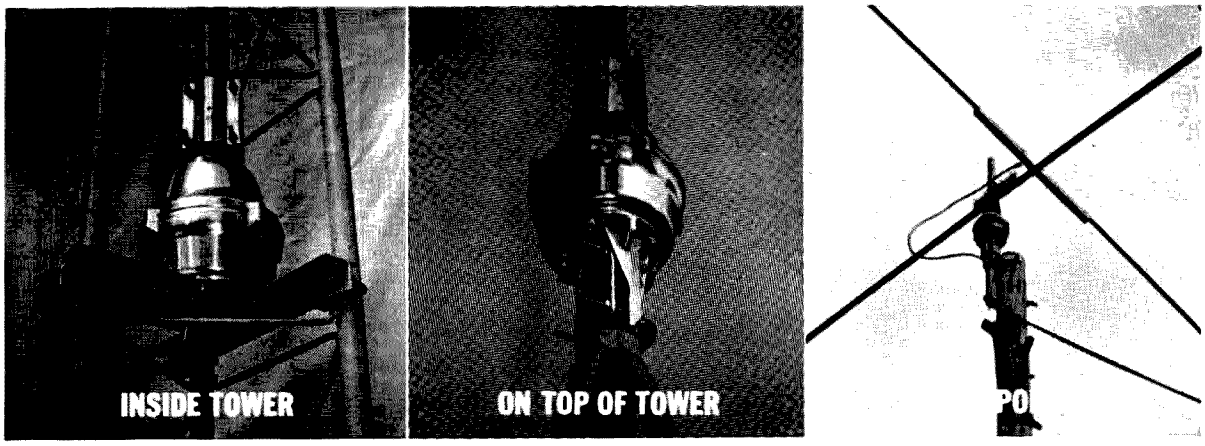


Fig. 1



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the principle of passing a low frequency audio signal from the receiver through a bandpass filter, rectifying this ac signal and using the dc voltage thus developed to trigger an external oscillator. In this manner the operator was hearing the triggered oscillator and not the original signal as presented by the receiver. This circuit presented an idea which seemed to have considerable promise, however the unit as described had several weaknesses as some of you who tried it found. They were, 1—inadequate filter, 2—something less than positive keying, 3—tricky to adjust and 4—no way of actually hearing the original signal from the receiver simultaneously with the keyed version. This latter feature, at first glance, might not sound important, but those of you who may have tried this device can attest to the utterly helpless feeling you experienced when the oscillator ceased to trigger and you were confronted by a deep silence, with no way of knowing if your contact had drifted up, down, or just faded away.

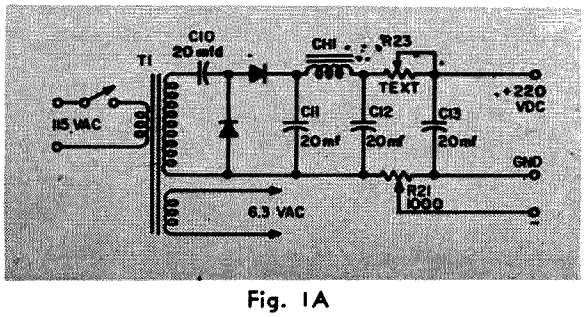
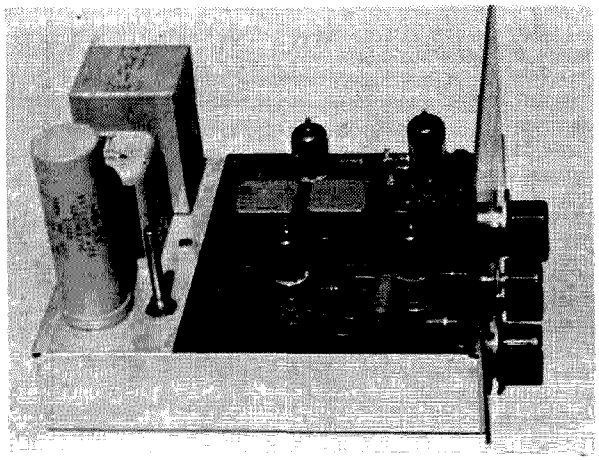


Fig. 1A

The unit to be described here is related to the original device, but has overcome the undesirable characteristics of its predecessor.

Looking at the schematic (Fig. 1) I will take you rapidly through the circuit operation and then go back and comment on the various details. The first tube in the unit, V1A and V1B, takes the signal as received from the receiver and amplifies it through a very narrow passband filter. This filter is placed in the plate circuit of the amplifier tubes and consists of two high Q inductances tuned to the desired frequence by two condensers. The signal is then rectified by two diodes in a voltage doubling circuit with the resultant dc voltage used to trigger a flip-flop multivibrator, V2A and V2B. This multivibrator then turns "on" and "off" a keyer tube (V3A) which keys a neon oscillator, the output of which is fed into the grid of V4B, and into the output of the unit. The second input channel goes to V3B where, bypassing the filter, it is amplified and passed to the grid of V4A. There it is mixed with the output of the neon oscillator and presented to the output. It is apparent even by now that this device has corrected the major difficulties incident to the original model.

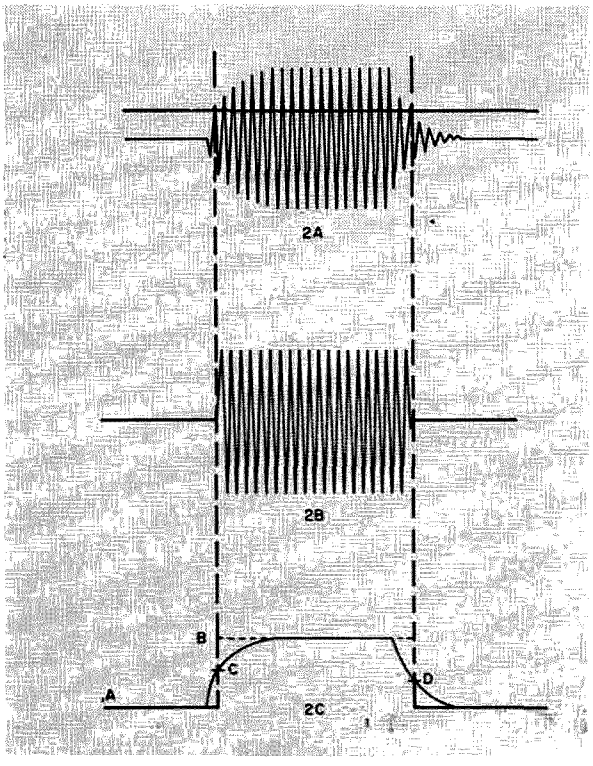
A more detailed breakdown of this circuit is as follows: The first tube V1A and V1B has, as its two plate loads, a high Q tuned circuit



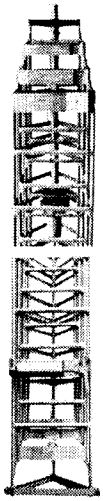
which is resonated, in this case, to 500 cycles. As you know, selectivity is a percentage situation, so to get a real narrow passband a low frequency signal from the receiver must be used. A frequency lower than 500 cycles could just as well be used if more selectivity is desired—more about that later. The two inductors used in the filter here are UTC variable inductors of the V1C type. These are roughly tuned to the desired frequency by the capacitors C3 and C4 with the final peaking done with the slugs. Any type inductors can be used, but the job of peaking will have to be done by padding the condensers and this is much harder than turning a slug. A V1C-15 will tune to 500 cycles with a condenser of 0.02 shunted in parallel. However if you wish to change the resonant frequency to a lower value use the formula $F = \frac{1}{6.3\sqrt{LC}}$ where C is in farads and L is in henrys. Remember again that the lower the resonant frequency the better the selectivity. The inductances used in this model are VIC-9 which have a low inductance requiring a rather large condenser in shunt. This lowers the Q somewhat and increases the bandpass, but even this unit has a bandwidth of 90 cycles at the 3db point.

The audio signal leaving V1B is then fed into a voltage doubling rectifier circuit which uses any good diode such as the 1N63 or the older 1N34. The diodes are connected to furnish a positive voltage output. This rectified voltage is then smoothed by C6 and fed into the multivibrator input circuit. C6, by the way, does more than just smooth the rectified voltage; the noise spikes from auto ignition, vacuum cleaners, etc., are effectively taken out by this condenser.

The multivibrator circuit, V2A and V2B, is the heart of this unit and as such warrants some detailed discussion. Going back, if you pass a square wave, such as a keyed CW signal through a high Q circuit with its high selectivity you reshape the square wave very badly. This is what causes the ringing sound. Figure 2A shows a typical keyed CW "dot" after passing through a narrow passband filter circuit. This sloping of the start and finish shows why it is so difficult, if not impossible, to directly copy the output of such a filter. While the rectified voltage, as fed to the multivibrator, looks like "a" on 2C, if the action of the multivibrator can be made to take place at some voltage above zero as on line "x" of 2A and the neon oscillator can be keyed on at this point then the tone, as heard, will start at "c" on 2C and stop at "d." This will give an output signal shaped as shown in 2B, effectively eliminating the slope, or ringing, of the selective filter. This is done as follows. The multivibrator circuit is designed so that V2B is normally in a saturated condition. Under these circumstances V2A, which is cut off, or nearly so, has the full plate voltage at its plate. This voltage when applied to the grid of V2B through R10, consequently holds this grid at a slightly positive (or zero) voltage. This, as mentioned, causes plate current to flow through V2B and causes a large voltage drop through R12. This lower voltage fed through R9 to the grid of V2A fails to overcome the negative bias voltage on this grid and leaves it at a negative potential, or the tube in a cut off (or nearly so) condition. This multivibrator is known as a flip-flop circuit which means that it can rest in either the condition described or in the reverse condition, in which V2A is heavily conducting and V2B is cut off. However, in this application the circuit is unbalanced which means that, while at rest, V2A will always be in the cutoff condition and V2B will always be in the heavy current carrying state. Now when a signal passes through the



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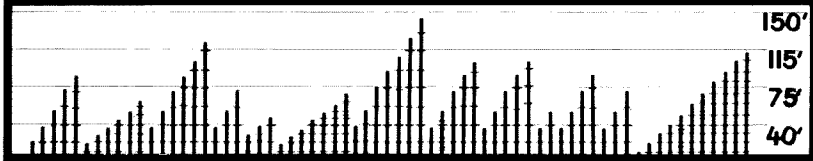
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filter and is rectified into a positive pulse by the diodes and applied to the grid of V2A it overcomes the negative bias and starts a current flow through the tube. This in turn increases the voltage drop through R8, decreasing the voltage at V2A plate which, in turn, decreases the positive grid voltage on V2B allowing the bias to take over on that tube, thus decreasing the plate current flow through its plate load resistor R12. This, of course, increases the voltage on the plate and, feeding this increased positive voltage through R9 to the grid of V2A enforces the original positive signal pulse and flips the circuit over to the opposite condition it assumed while at rest. Now when the signal is removed by the end of the dot being sent, the voltage on the grid of V2A goes down and starts the entire sequence in reverse, Forcing the circuit to flop back to its original condition. This is why this circuit is known as a flip-flop circuit, with its characteristic ability to change rapidly (a few microseconds) from one condition to the other.

Just how does this apply to this device? Let's look at Fig. 2 again. Let's say, for example, that the signal is plus 2 volts in value with the trigger level set at plus 1 volt (line "X" on 2A or at points "C" and "D" on 2C). Looking at 2C again, as the signal voltage builds up from zero to one volt (point "C") the multivibrator remains in the original no signal condition, however upon passing the one volt lever V2A starts to conduct and due to the action of the multivibrator instantly flips over to full reverse condition from the original state. At the end of the dot the voltage at the grid of V2A starts to fall as shown on 2C and as it passes point "D" the plate current of V2A starts to fall thereby reversing the sequence of events with V2B and flopping the circuit instantly back to the original condition.

Now why do we do this? We have taken a square burst of signal, representing a dot for example, and in passing it through a high Q selective circuit have destroyed its original shape and then we have reshaped it back to its original shape by the action of the multivibrator. This will allow us to use this reclaimed signal to trigger an oscillator on and off to give us a clean, positive keyed output signal thus overcoming one of the prime objections to the original circuit of a few years back.

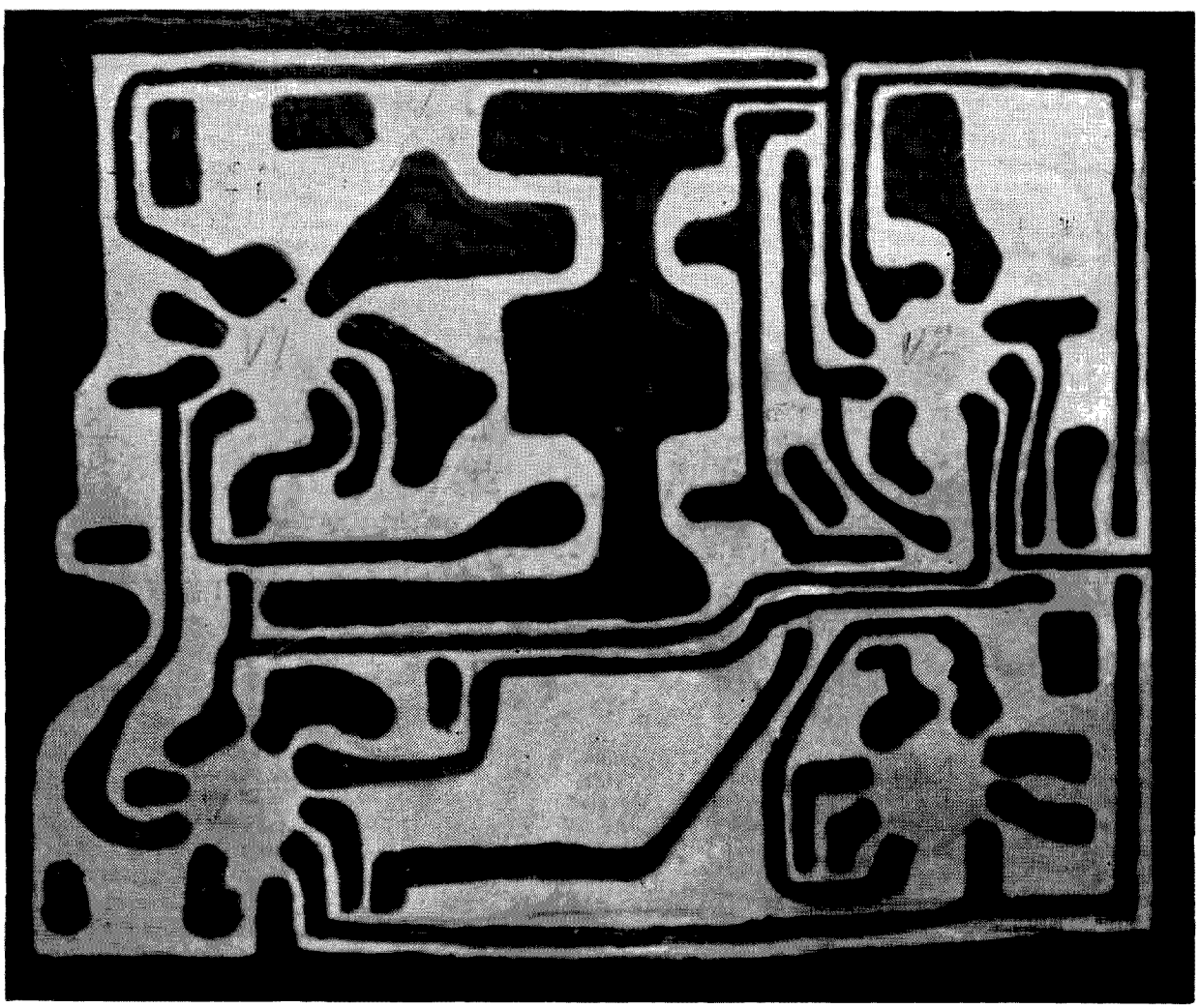
The oscillator is a typical neon bulb relaxation oscillator comprising of R13, R23, R14, C7 and the neon bulb NE1. This circuit would be normally oscillating except for the action of the keyer tube V3A. This tube has its grid in parallel with the grid of V2B so that in a normal no signal input condition the same plus voltage is applied to its grid as is applied to the grid of V2B. This saturates the tube which causes such a large voltage drop through R13 and R22 that the neon bulb fails

to oscillate. When the signal is applied to the unit the multivibrator tube V2 flips over, which cuts off the plate current of V2B and V3A. This cut off condition of V3A removes the tube load through R13 and R22 thereby raising the voltage on the neon bulb thus allowing it to start oscillating. When the signal ends, the multivibrator flops back and stops the neon bulb from oscillating—this explains the "why" of the multivibrator.

The output of the neon bulb is then taken off R14 and fed into V4B where it is amplified and delivered to the output phones, or possibly a small speaker. A speaker will probably need another stage of amplification however.

The second channel comprising of V3B and V4A is a straight amplifier which takes the normal output of the receiver, before it passes into the filter circuit, and after passing through V3B is fed into V4A. It is there amplified and mixed with the output of V4B by the common plate load resistor R17. Either signal can then be heard, or both can be heard at once, depending upon the setting of the individual volume controls R14 and R18. For normal use R18 is set for comfortable output level and with R14 set at zero, a signal is tuned in, in the normal manner. If interference conditions require it then R14 can be increased and the receiver tuned (or the BFO adjusted) until the beat note is of the proper frequency to pass through the filter network. The neon tube will then be triggered and can be heard in the output by advancing R14. The original signal with its interference, coming in on the other channel through R18, can be eliminated by turning down that volume control until it no longer bothers—to zero if you desire. The interfering signal must be outside of the passband of the filter of course but since this band is only 90 cycles wide at the 3db points, and can be made much less than that by lowering the resonant frequency of the filter, this usually can be accomplished.

The power supply is normal with nothing critical. The only thing about it, which might be termed unusual is R21, which sets the negative bias on V2. The value of this potentiometer might have to be changed if a lower plate voltage is used. If so a 2K potentiometer should be OK. The important thing is to have the grid voltages on V2 as described. R23 can be adjusted to set the plate voltage to 220 vdc if it is normally higher, or can be omitted if the output voltage is below 220.



Perhaps we should go through a brief "set-up" procedure for the unit. By steps it is as follows—

1. Remove V1, V2, V3 and turn on the power supply.
2. Adjust R23 (if used) to give approximately 220 vdc to the unit.
3. Plug in a pair of fones and you should hear the neon bulb oscillating. Adjust R13 for the tone desired and R14 for the correct volume.
4. Insert V3 and allow warm up time. The tone should stop.
5. Plug the unit into receiver, or into an audio oscillator, and adjust R18 for proper volume of signal heard in the output.
6. Insert V2 and allow warm up time. No change should occur.
7. Insert V1 and allow warm up time. With no signal into the unit from the receiver, or oscillator, no change should be detected. With a signal in, if it is of the proper audio pitch, it should key the neon bulb, which can be heard in the output. Adjust the receiver gain until the noise does not trigger the unit.
8. Now tune in a signal in the normal manner and, as the tone goes through the passband of the filter the neon should plop into oscillation in step with the signal and you can hear either one individually or both at once as you desire. If you use a filter frequency of 500 cycles or lower this neon signal will plop in and plop out as you tune the receiver leaving interference noise, etc., noticeably absent.

In case, after step 4, the neon tube does not stop oscillating, check the voltage at the grid of V3A. This should read zero or slightly positive. If it is not—and after the wiring has been checked for a mistake—check the voltage on the grid of V2A—this voltage should be approximately one volt negative. In case these readings are reversed with V2A positive and V3A negative and the wiring checks out OK, the value of R11 will have to be changed. In fact it might be advisable to put R11 in as a pot. of 20K value and mount it on the back of the chassis—especially if you deviate from the 220 volts dc used on this unit. The plate voltage is not at all critical, in fact and anything from 100 to 250 volts can be used—if you adjust R11 and R21 for whatever you're using. Going back, if the grid of V3A is not zero or slightly positive with no signal input it must be made so by the adjustment of R11. Then with a signal going through the filter, the grids of V2 will flop back and forth from zero to minus. The readings should be, for V2A, from approximately minus one volt to a plus half volt or so and for V2B (and V3A) from approximately zero to three volts negative or so. These are the only critical features of the unit, and these are not especially so.

You have noticed from the photo that this unit is constructed on a printed circuit board. This is for no special reason except that I recognize this to be a good method of construction and enjoy laying out the boards. It was done in my home workshop using a small artist brush and ordinary enamel for the resist (the name for the material which covers the copper that is to be left after etching). The etchant acid was placed in a glass dish and warmed slightly before the board was immersed. This warming is not necessary, but it speeds up the process. A very mild warming is sufficient, in any event, and for best results keep stirring the acid with a wooden paddle while the etchant is working. Laying out the circuit board is not complicated, but is tricky and probably could be the subject for an article in itself. If it is desired to copy the board used here, Fig. 4 is an exact layout drawn to scale.

This completes the description of the unit. It will be found to be a very real assist in copying signals through QRN and QRM. One of the requirements is, of course, that the desired signal be not too far down in the mud. If the noise triggers the neon while you are trying to dig out the signal the device is of limited use. However, the action of C6 does a good job of eliminating noise peaks, so many times it would appear that you are, in fact, below the noise level while the unit is operating satisfactorily. Generally speaking this unit will be of the most value to the Novice or "rag chewer." It would seem that by the condition of the bands these days only Heaven can help the DX hound.

One more comment on the circuit—one resistor that shows on the schematic is R6. This potentiometer was used to set the threshold level for the neon oscillator keying and theoretically was a useful adjunct to the unit, however, in actual practice it was found to be excess baggage and it is recommended that it be omitted. The threshold is set close enough by R5 and the volume control of your receiver can be used to meet the level requirements very easily.

The unit as described, is, in fact, a prototype and any builder can probably improve upon it with a little thought. But in any event if you think you need some more selectivity for your code contacts—and who doesn't—get the old head gears turning, the soldering iron out and give it a go. . . . W6EUM

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Using the Rate-of-Change Noise Limiter

Larry Levy WA2INM

THE rate of change limiter is one of the first big advances in noise limiter design that we have had in quite a while. I won't go into a description of all the advantages of the limiter as Jim Kyle K5JKX, has done an excellent job of that already. (See 73 magazine, Apr., 1961, P. 16.) After looking at table 1 of Jim's article, I decided to see if those seemingly impossible figures were true. To do this, I installed a rate of change limiter in my 2 meter mobile transceiver.

The original circuit had a few faults, but these were mainly in connecting the limiter to a receiver. One problem was that there was no place to connect the AVC line, and another was that there was no way to disable the limiter, if only for comparison purposes.

The necessary modifications are shown as bold lines in the schematic. AVC voltage equals that from a standard diode detector. The diodes used were a pair of 1 N295s but a 12AL5 would probably work better.

I noticed that the addition of the limiter lowered the audio slightly so if your rig does not have spare audio gain, it may be necessary to add another stage of audio. A nuvistor will work fine and takes up very little space. Details are shown in Fig. 2. Since my trans-

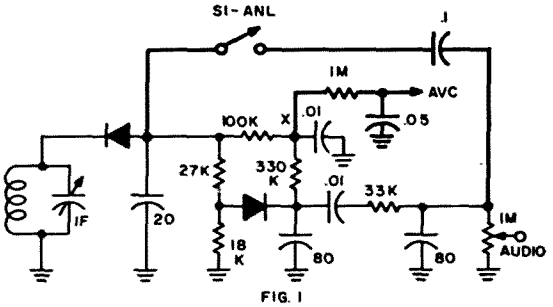


FIG. 1

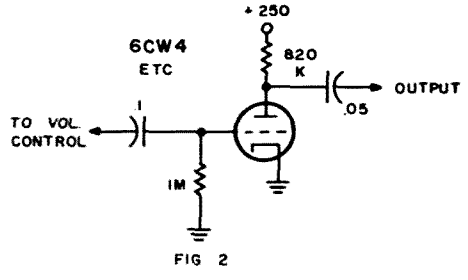
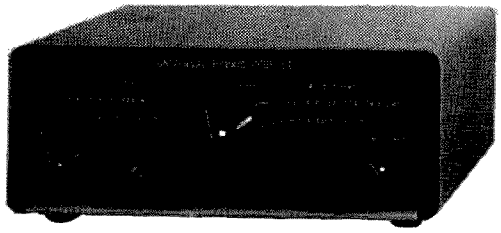
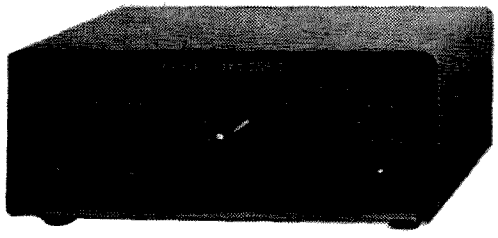


FIG 2

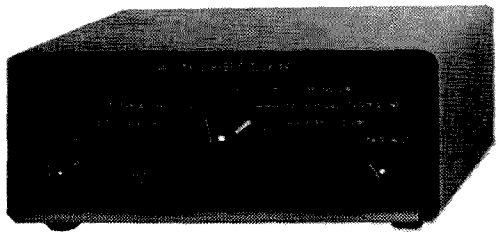
WHAT IS IT?



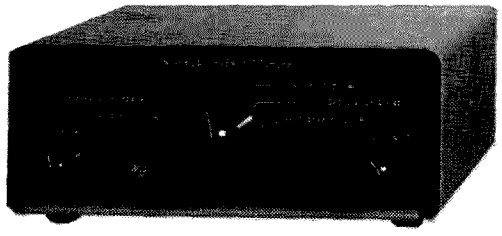
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See page 54 in Sept. '62 73.

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ceiver uses a series-parallel heater string, it was necessary to change the 6U8 to a 12AX7 and connect the nuvistor in parallel with the 12AX7. Another solution would be to add a second nuvistor as an rf amplifier.

The results are amazing, as the limiter completely eliminated all ignition noise from my XK-140, which was so noisy that I gave up trying to operate 2 meter mobile from it. With very little effort, it should be possible to add this limiter to any receiver, and eliminate almost all qrn. . . . WA2INM



Roy Pafenberg W4WKM
John Bowden W4SYJ

73 Tests the

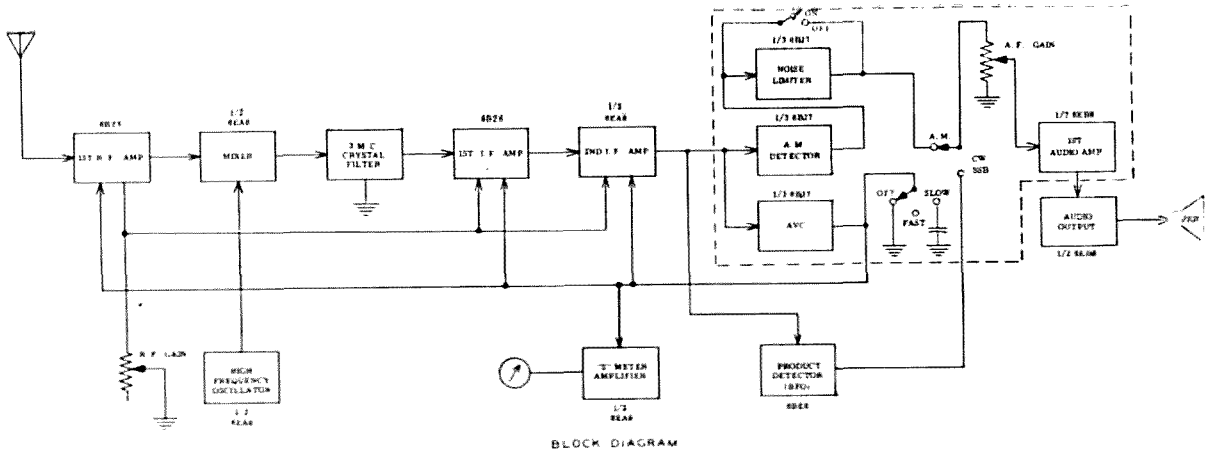
Heath HR-20 Mobile Receiver

—ANOTHER MOBILE RECEIVER? Well, not exactly. While Heath calls their new HR-20 kit a mobile receiver, an SSB receiver and, at times, a mobile SSB receiver, it is more than this. The HR-20 is an advanced design amateur band receiver, less power supply, which provides, in a compact package, those receiver characteristics and features which Heath believed would provide the most performance for the money. As far as the writers are concerned, Heath has a winner.

The HR-20 Receiver is a 7 tube (plus gas regulator, Zener diode and transistor regulator) single conversion superheterodyne receiver designed for CW, SSB and AM reception in the 80 through 10 meter amateur bands. Modern design techniques and components insure excellent performance in all modes. Before we go into the circuit details, a few comments regarding the design philosophy and history of the HR-20 Receiver are in order.

As shown in the photograph, the physical configuration of the HR-20 is similar to that of the previous Heath mobile receiver, the MR-1 Commanche. Much of the circuitry, the panel layout and physical dimensions of the original model have been retained. The major changes are in new features for improved SSB reception. Included in these are replacement of the original variable frequency BFO with a dual frequency, crystal controlled oscillator for selectable sideband operation, selectable AGC time constant and a transistorized high frequency oscillator filament voltage regulator for 12 volt dc mobile operation.

The initial design concept for the HR-20 was as mobile receiver to be used in conjunction with the Heath HX-20 Mobile SSB Transmitter. When used in this application, both units may be mounted on an accessory base which is available as the AK-6 Mobile Base Mount. Such an installation is shown in the second photograph. An external, 8 ohm speaker is required and the AK-7 Mobile Speaker is available for this purpose. Heath also markets the HP-10, 12 volt dc power supply for mobile use. This transistorized, 120



BLOCK DIAGRAM

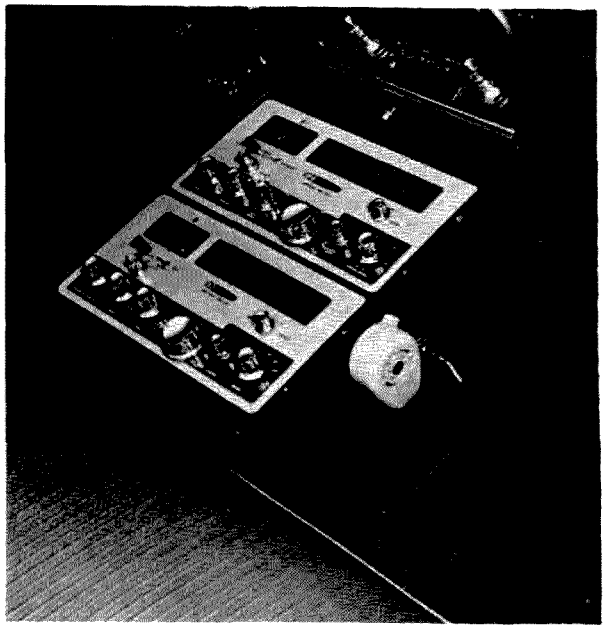
watt unit supplies power for both the HR-20 Receiver and the HX-20 Transmitter in the normal mobile installation.

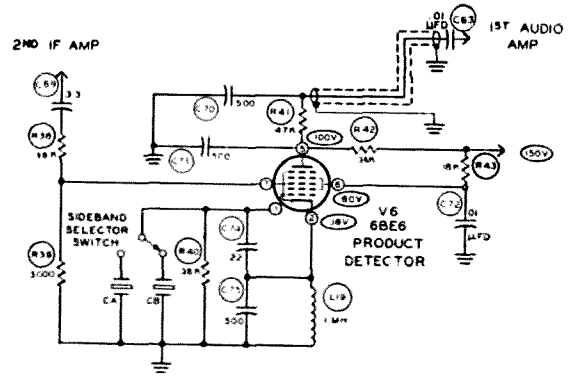
Both the HR-20 Receiver and the HX-20 Transmitter are well suited for home station use and, in this application, Heath recommends their HW-20 Utility ac Power Supply. Although the HR-20 is designed for easy integration into the home station or mobile installation, it may of course be used as a straight, ham band receiver. In this case, all that is required is an antenna, speaker and a power supply considerably less elaborate than those mentioned above. Power supply requirements for the receiver alone are shown in the specification chart.

The HR-20 circuit diagram is a bit large to include in a review article, however the block diagram shown in Fig. 1 will aid in understanding the following discussion. The receiver is a single conversion superhet using a 3.0 mc *if* with a crystal lattice filter. A 6BZ6 rf stage feeds a 6EA8 mixer-oscillator stage which in turn feeds the crystal lattice *if* filter. Use of the relatively high, 3.0 mc *if* frequency, along with the selectivity provided by the high Q rf and mixer grid circuits, gives good image rejection. The crystal lattice filter provides the *if* bandpass characteristics required for effective SSB reception. The HFO tuned circuits are individually temperature compensated to insure low drift. This coupled with rugged construction and the use of a transmitting type variable capacitor provides a high order of stability for the HFO. This capacitor is a two section unit which also tunes the mixer grid circuit. The rf input circuit is resonated by a single section capacitor designated "ANTENNA TUNING." While slightly unconventional, this arrangement allows use of the compact transmitting type capacitor for the oscillator-mixer tuned circuits and permits better physical layout of the stages.

The selectivity characteristics of the crystal filter, listed in the specifications, provide a very good compromise between the requirements for AM and SSB reception. Selectivity is sufficently sharp for effective SSB reception while an AM signal may be centered in the passband without loss of intelligibility. Two stages of *if* amplification, using a 6BZ6 and the pentode section of a 6EA8, follow the crystal filter and provide most of the receiver gain. The second *if* amplifier feeds either a conventional diode detector for normal phone operation or a product detector for CW, SSB and exalted carrier AM reception.

A conventional diode gate noise limiter, which is disabled when the product detector is used, is provided for AM reception. A separate diode AGC detector is used for gain control and to drive the triode section of a 6EA8 tube which is used as an S-Meter amplifier. The AGC circuit used in the HR-20 provides AGC operation for both AM and SSB reception. A front panel switch provides





short or long time constant or disables the AGC as desired.

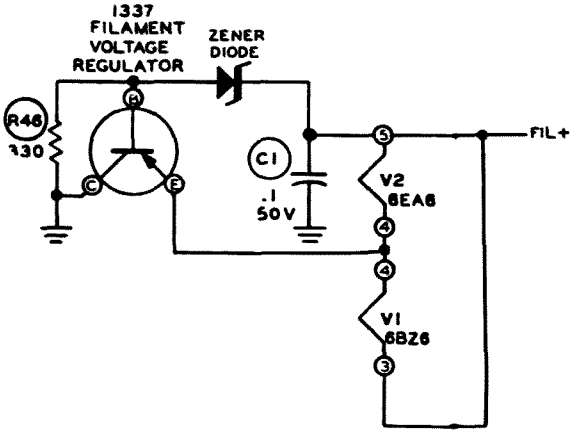
The product detector utilizes a 6BE6 pentagrid converter as the mixer and crystal controlled oscillator. This circuit provides very good performance with a minimum of components and should be of interest to amateurs seeking improved SSB reception with their conventional home brew or commercial receivers. Fig. 2 shows the schematic diagram of this circuit. Crystals CA, 2998.5 kc, and CB, 3001.5 kc, are positioned 1.5 kc below and above the 3.0 mc center frequency of the crystal filter. Therefore, selectable sideband reception is possible by positioning the oscillator on the upper or lower slope of the crystal filter selectivity curve. It should be noted that the "SIDEBAND SELECTOR" switch only selects the appropriate product detector crystal. It is still necessary to tune the main tuning dial to zero beat the crystal oscillator with the actual or suppressed carrier of the *if* translated, desired signal.

An OA2 gas regulator tube supplies a constant 150 volts to the plates of the two oscillators and to the screens of the rf amplifier, 1st mixer and the *if* amplifiers. The balance of the receiver circuitry is more or less conventional with the exception of the transistorized filament voltage regulator. This circuit, shown in Fig. 3, supplies a constant voltage to the heater of the 1st mixer-oscillator and rf amplifier tubes. This feature, used only in the 12 volt dc power supply wiring option, stabilizes the oscillator filament voltage and therefore contributes to the excellent frequency stability of the high frequency oscillator over the wide range of primary voltage encountered in mobile service. Regulation of the rf stage is incidental to a simple 6 or 12 volt wiring option.

This circuit should be of value to those who have been fighting the complex problem of mobile VFO stability. The parallel connected heaters of V1 and V2 are wired in series with the emitter follower transistor circuit. The base input voltage of the transistor is the breakdown voltage of the Zener diode which is relatively constant for a wide range of supply voltage. Resistor R46 provides the base drive current for the transistor and breakdown current for the Zener diode. Since the base to emitter resistance is quite low, the emitter potential is held to a value slightly lower than the base. The overall effect is that the unwanted voltage variations appear between the emitter and collector of the transistor while the voltage applied to the tube heaters is regulated.

One of the first kits off the production line was shipped for this test. The kit was well packed and, on unpacking, no damage of any kind was noted. All components were examined and found to be of excellent quality. Dipped mica and disc ceramic capacitors are used extensively. The only paper capacitor in the receiver is a high quality molded plastic cased unit. Insulation on all rotary switches is apparently one of the new plastic laminated fiberglas materials. Mechanical parts are high quality. Dial drive gears are spring loaded where required and nylon, brass and steel gears are used. All exposed steel surfaces are heavily plated.

Mechanically, the receiver is quite complex, consisting of a main chassis assembly secured to a heavy, die cast front panel. Subpanels are used to mount the various controls, gear drive for the dial and some other components. Extensive shielding is used. The result, when everything is bolted together, is an extremely rugged assembly that contributes greatly to the stability of the receiver. However, construction is not unduly complicated. The main chassis consists of a flat plate on which most components are mounted and most of the wiring completed prior to mechanical assembly of the chassis parts is accomplished. As Heath points out in the form letter packed with the kit, "This receiver is one of the more complex and compact products marketed in kit form by



the Heath Company." Assembly, wiring and testing is not difficult but plenty of time and careful attention to detail are required.

The instruction manual supplied with the HR-20 was evaluated as the kit was constructed. This manual is quite comprehensive, consisting of 64, 8½" x 11" pages. The manual contains some 50 drawings showing the assembly, wiring and installation of the receiver. Many of the more complex assembly drawings are printed on large, fold-out sheets. In addition, a separate "giant size" schematic diagram is supplied for wall mounting. Construction, testing and installation are covered by nearly 500 "check off" steps. These instructions are arranged so as to be self checking and it would indeed be difficult to goof any part of the construction.

Three minor errors, possibly typographical, were found in the instructions. Since the errors are obvious and Heath is correcting them with an errata sheet, they will not be listed here. The pictorials were remarkably good and the only error noted was omission of a small nylon washer in the gear drive assembly. All parts are shown in drawings in the front of the manual so that even the relatively inexperienced amateur should have little difficulty in identifying the components. Separate sections of the manual are devoted to installation and noise suppression. All in all, the manual is extremely good.

Assembly, with minor exceptions, proceeded according to the instructions. The hermetic seal bushings on the bottom of the crystal filter would not quite pass through the chassis clearance holes. A pass with a file took care of this problem. The same was true of the crystal socket mounting holes. Wiring was easily accomplished. The flat, open main chassis plate makes it a snap to achieve professional results. Despite the apparent complexity of the dial drive assembly, it goes together quite easily. One "E" retaining washer required bending to make a snug fit in the shaft groove. Only one case of crowded assembly was noted. The audio output stage screen filter capacitor, a 20 mfd 350 volt unit, barely fits as shown in the instructions. This is probably accounted for by the increase in value (and physical size) over the 8 mfd capacitor shown in the pre-production schematic diagram.

The completed receiver was carefully checked before power was applied. Everything checked out so power was applied, with no smoke resulting. Alignment was started but stopped when high pitched, audio feedback was noted at certain settings of the audio

B&W

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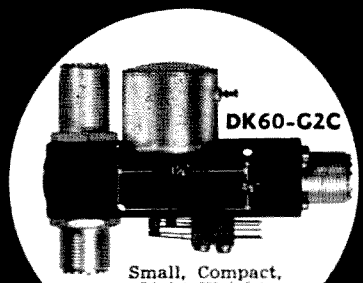
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gain control. Wiring, lead dress and components were checked with no luck. Finally, the .001 mfd capacitor across the primary of the audio output transformer was replaced with a .002 mfd unit. This proved to be a permanent fix. The oscillation was probably caused by an unusual combination of extreme tolerance components. However, to avoid the possibility of this occurring in other receivers, we recommended to Heath that this change be incorporated in all kits. The balance of the alignment went smoothly with no complications of any kind. Heath proved correct in their estimate of the time required to complete the kit, roughly 30 hours from start to finish.

Then came the pay-off—the "on the air" tests. Be advised that the performance of the receiver is all that the specifications say it is. Sensitivity is extremely good, with receiver noise way down. The selectivity, as previously mentioned, is a very fine compromise between the requirements for SSB and AM reception. CW is of course another story; a valid comparison is the CW performance of the Collins 75S-1 with SSB filters. Interference on one side of the desired signal may be "dropped over the edge" of the crystal filter bandpass but you have to live with what is left on the other side. While audio gain is adequate, there is no great reserve.

Tuning SSB signals is a pleasure. The dial ratio is about the optimum compromise between SSB tuning requirements and the need to scan each amateur band in one receiver tuning range. While a dual speed drive would probably be better, the resultant complexity might prove prohibitive for kit construction. Although the gears are spring loaded, a slight roughness was noted in the tuning drive. Based on experience with previous Heath gear drives, this is expected to diminish with use. The AGC system used in the HR-20 is excellent, with very effective action being obtained on SSB signals. Use of selectable AGC time constants really pays off in SSB reception.

Frequency stability of the HR-20 is extremely good. After all, the stability requirements for mobile SSB reception are demanding to say the least. Total warm-up drift on 20 meters was 3 kc from an absolutely cold start. After warm-up, the receiver is rock stable. The receiver was heterodyned with a 10 meter signal; lifted a couple inches off the bench and dropped. The result was an instantaneous "gurgle" but the beat note did not change. Try this test with other receivers; it is quite revealing.

The frequency stability of the HR-20 is of great interest to the writers. It would appear possible to convert the HR-20 Receiver to an SSB transceiver, using a small inboard or outboard adaptor unit. The performance of the receiver circuitry that would be used in such a conversion has proved more than adequate for the job. Therefore, plans are in the mill for this conversion. If it all pans out, this will be the subject of a future article.

For a really rugged final test, the HR-20 was compared side by side with a Collins 75S-1. The 75S-1 uses a system of sideband selection where both the HFO and BFO frequencies are shifted with a single switch. This feature, coupled with the better dial ratio, made the 75S-1 easier and more convenient to operate. However, for actual performance, the Heath receiver did not suffer in comparison. Dollar for dollar, the HR-20 will be extremely difficult to beat. In the opinion of the writers, the HR-20 is the best buy on the market today.

. . . W4WKM and W4SYJ

SPECIFICATIONS

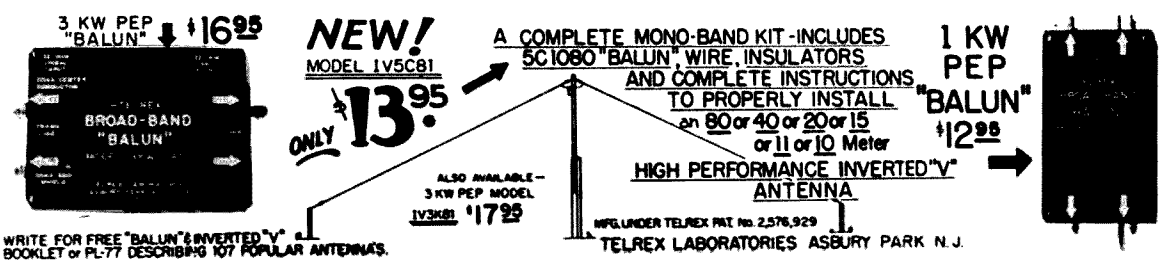
Frequency Coverage
- 80 Meters—3.5 to 4.0 mc
- 40 Meters—7.0 to 7.3 mc
- 20 Meters—14.0 to 14.35 mc
- 15 Meters—21.0 to 21.5 mc
- 10 Meters—28.0 to 29.7 mc

Intermediate Frequency
- 3 mc

IF Crystal Filter
- Mid-frequency—3.0 mc
- Bandwidth at —6 db—3.0 kc
- Bandwidth at —60 db—10.0 kc maximum.

Sensitivity
- 1 microvolt or less, at 10 db signal-to-noise ratio.

Panel Controls
- SB1-SB2
- RF GAIN
- AF GAIN, power OFF
- CW/SSB-AM
- NOISE LIMITER OFF-ON
- AVC, OFF-FAST-SLOW
- Main Tuning
- BAND switch
- ANT TUNING



Rear Panel Connectors
Antenna (ANT) 50-75 ohms
Power (PWR).
Speaker (SPKR) 8 ohms
Earphones (PHONES) 500 ohms
FUSE
Meter
Front panel "S" meter indicates received signal strength.
Tube Complement
6BZ6—RF amplifier.
6EA8—Mixer-oscillator.
6BZ6—First *if* amplifier.
6EA8—Second *if* amplifier and "S" meter amplifier.
6BE6—Product detector—BFO.
6BJ7—AM detector—AVC—noise limiter.
6EB8—First audio—audio output.
OA-2—Voltage regulator.
Power Requirements
Filaments: 12 v at 2.5 amp ac or dc.
6 v at 5 amp ac or dc.
B+ Voltage: 275-350 v dc at 85-125 ma
Total Power: 63.5 watts.
Cabinet Size
6⅛" high x 12⅛" wide x 9 15/16" deep.
Net Weight
16 lbs.
Shipping Weight
19 lbs.
Cost
$134.50.
Assembly Time
Approximately 30 Hours.

Letters

Dear Wayne & Virginia,

Enjoy "73" and sorry you couldn't get to the Disneyland Convention. I suppose you're going to be so busy fixing up your new location that it will be some time before you get out this way again. Remember, Virginia wants to see Disneyland. Don't work her to death feeding and making beds for the freeloaders. I'm an old Yankee and who knows, I may drive up to your place sometime with my bedroll and a slab of bacon and give you a hand. Good luck with your new location and "73".

Royal Bailey W6SEU

Editor,

Do you know of anybody using a Valiant on SSB with the SB-10 adaptor? I'm having a problem here after following the QST article, page 48, August 1960. I lost grid drive after installing switch SW4C. Perhaps some of your readers can help out.

C. J. Williams W1ROM
47 Lake Avenue
Old Orchard, Maine

Perhaps.

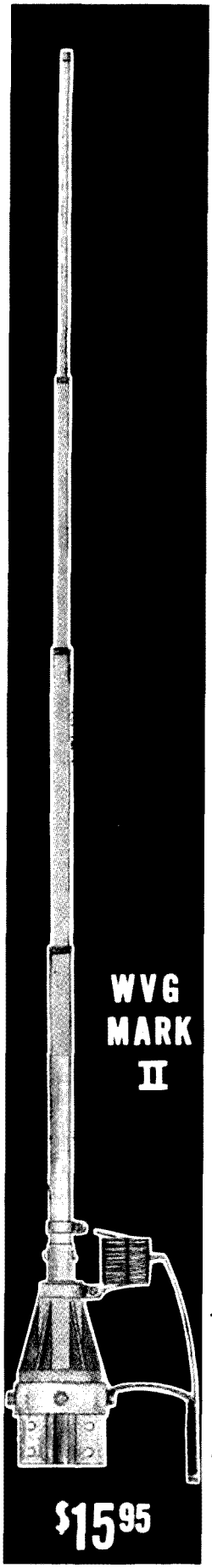
Dear Wayne:

Please print this in the "My face is red" column.

In reference to the Mobile Scope on page 36 of the August issue, I have received several comments such as, "It won't work." In order to make it work change the intensity and focus controls to 500K and the resistor in series with the focus pot to 1.5 meg. The power supply works better if the 25K bias resistor is changed to about 820 ohms and R2 to 130 ohms at 1 watt.

The external shell of the 913 is tied internally to pin 1 so grounding the shell shorts the power supply, leaving it ungrounded presents a shock hazard. This problem was solved here by coating the tube with several coats of Krylon and placing tape under the bracket. An alternate method would be to insert the 913 into a section of plastic tubing. If the scope is to be used in the shack use a separate filament transformer for the 913 and move the HV ground to pin 1 of the 913.

Robert L. Williams K9DYS



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WRL

WVG MARK II

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Conveniently used when installed on a short 1-5/8" mast driven into the ground. Simple additional grounding wire completes the installation. Roof top or tower installation. Single band operation ideal for installations of this type. Amazing efficiency for DX or local contacts. Installed in minutes and can be used as a portable antenna.

Mechanical Specifications: Overall height — 18' Assembled (5' Knocked down) Tubing diameter — 1¼" to 7/16". Maximum Wind Unguyed Survival — 50 MPH. Matching Inductor — Air Wound Coil 3½" dia. Mounting bracket designed for 1-5/8" mast. Steel parts irridite treated to Mils Specs. Base Insulator material — Fiberglas impregnated styrene.

Electrical Specifications: Multi-band operation — 10-80 meters. Manual tap on matching inductor. Feed point impedance — 52 ohms (unbalanced). Maximum power — 1000 watts AM or CW-2KW PEP. Omni-directional. Vertically Polarized.

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AM Oscilloscope Patterns

Harvey Pierce WϕOPA
5372 E. Bald Eagle Blvd.
White Bear Lake 10, Minnesota

THESE ARE TYPICAL patterns as seen on the "Simplescope" (See Sept., 1961, "73 Magazine") hooked to an AM transmitter. Any other 'scope with its vertical plates connected to an rf pick-up will give envelope patterns as shown, even from a receiver *if* output. For the trapezoid figures, though, the horizontal plates must be connected direct, without amplifiers, through a dropping resistor only if needed, to the modulating voltage. Most commercial scopes do not provide for this type of connection.

A 'scope gives instantaneous reading, so the majority of these drawings represent a fleeting picture, not a steady state. They are idealized and simplified, yet the viewer should be able to recognize, from them, when a similar condition exists in his transmitter. Oscilloscope patterns change constantly as the modulating voice changes, yet over all they obey certain rules for certain conditions. Let's look at the pictures and see.

A. This is the undeflected spot. It should be small and round. "Z" is the horizontal reference line (imaginary) drawn through the spot, representing the point of zero rf output.

B. This is the unmodulated carrier of a trapezoid pattern. Length "X" represents rf output (carrier) voltage. The rf coupling to the 'scope should be adjusted so that "X" is not over 1/3 the diameter of the 'scope face.

C. If the vertical trace is wider than the spot seen as in drawing "A", there is hum or noise in the audio system or in some cases the power supply.

D. Speaking in the microphone should produce a pattern like this. (A trapezoid.) The horizontal or "Width" control (audio coupling) should be adjusted so the slanting sides of the figure are from 30 to 45 degrees to reference line "Z".

E. This is exactly 100% modulation. In a perfectly modulated transmitter, "Y" should be twice "X". (It rarely is!)

F. This is overmodulation. "Y" is now more than twice "X". "A" should be equal to "B" plus "C", but in practice it rarely is. Portion "C" is a bright horizontal line, and indicates the amount or degree of overmodulation on negative peaks of the audio cycle.

G. This is phase shift between the audio to the 'scope deflection plates and the audio doing the modulating. Any amplifier or coupling except a simple resistor between the horizontal plates and the modulating audio will cause this pattern. The "loop" changes shape with voice frequency changes.

H. Here is a picture of a slight case of what is termed "a lack of modulation capability." Note the rounded left-hand corners.

I. A severe case of "lack of modulation capability."

J. A typical pattern of lack of modulation capability. There are many causes. For plate modulation the commonest cause is lack of grid drive or (what amounts to the same thing) over-coupling to the antenna or load. Other factors may be bad or overloaded final tubes, poor power supply regulation, or an overloaded power supply. In screen, grid, or other forms of "efficiency" modulation this pattern usually means improper operating voltgages. In a few circuits nothing will help, for they are just incapable of linear modulation.

K. This is the pattern for choke or Heising modulation with the final heavily loaded and the modulator tube(s) operating class AB2 or B. Note that "Y" is a little greater than "X", and "A" is much smaller than "B" indicating essentially negative modulation.

L. The ideal pattern for negative peak clipping. "A" is greater than "B" showing extra positive modulation. Right hand point is bright and rounded showing clipping action.

M. "Envelope" pattern for unmodulated carrier. This and the rest of these pictures show patterns seen with 60-cycle ac applied to the horizontal plates instead of the modulating

A
Z
B
X
C
D
30°
E
Y
X
F
A
B
C
G
H
I
J
K
L
M
N
O
P
Q
R
S
Z
Y
X
T
U
V
W
X

audio voltage. Rf coupling the same as before. Width is set so that all four corners are seen for hum analysis, but may be expanded if desired for more detail on other patterns.

N. 60-cycle in- phase hum. Rare. Top and bottom of pattern not parallel.

O. The commonest pattern for 60-cycle hum. The open "loop" shown here at the right end may occur at other places.

P. 120-cycle in-phase hum. Rare. Edges MAY bow out rather than in.

Q. 120-cycle hum, commonest form. Same as "O", but with two loops per edge.

R. Noise. Top and bottom edges, rough and constantly changing. Sometimes called "grass."

S. Modulation. Note that TWO patterns appear, one as the trace moves left-to-right, another as it reverses to go right-to-left. The audio waves will be in constant and confusing motion but it is only essential to judge the distance "Y" (the audio peak-to-peak voltage) and compare it with "X" (the carrier) or what is easier the amount "Z" of carrier not modulated by the audio. Either way you can judge modulation percentage.

T. 100% modulation. "Z" has reached zero, and "Y" is now equal "X". Bright dots appear along the center line as the negative peaks meet in the middle of the pattern.

U. Over modulation. "Y" may be greater than "X", but the most important indication is that the bright dots of pattern "T" have now become dashes, indicating periods of no carrier.

V. Clipping. "Z" has a steady value, and the peaks of the audio wave can be seen to be flattened. This is sometimes caused by saturation of the modulation transformer (core not big enough for the power).

W. High frequency "Spiking." The spikes are 2 or more times the height of the rest of the audio waves. Usually caused by "ringing" (momentary oscillation at a high frequency) in an audio transformer, triggered by the high frequencies that naturally occur in speech.

X. This is the envelope equivalent of trapezoid pattern "K". Trapezoid patterns "I" and "J" will look like this, too.

Even with the rapidly changing double trace of the envelope pattern it should be possible to distinguish between smooth and rough modulation by fleeting glimpses of the audio waves. Distortion usually shows up as excessive highs, similar to pattern "W." With a commercial-type scope the regular sawtooth sweep set at near 60-cycles with internal sync will hold most audio waves steady for good viewing.

In actual practice the wave forms in the envelope pattern will be much more complex than those shown. A sharp eye should have no trouble in recognizing the typical conditions illustrated, tho. In general the envelope pattern is best for telling what kind of audio waves you have doing the modulating, while the trapezoid pattern is best for showing how the rf is being modulated.

In a typical ham shack the envelope pattern need only be used to check newly installed audio equipment (clippers, preamps, microphones, etc.) while the trapezoid pattern should be used constantly to monitor modulation percentage and the modulation capability of the rf stage being modulated (adequate drive, etc.).

Envelope for your audio, trapezoid for your modulation.

. . . WϕOPA

Letters

Dear Wayne,

Regarding the article on page 22 of the September 1962 issue: Treasures in the Junk Yard. Auto radios run fine on 6 vac if they have permanent magnet speakers, but do **not** work with field coil speakers. They play, but sound like hell. $10 or $15 seems like a lot for old car radios. I have purchased a dozen or so in the last 15 years for 25¢ to 75¢ and have had a half dozen more given to me.

John Marlatt K7AGI

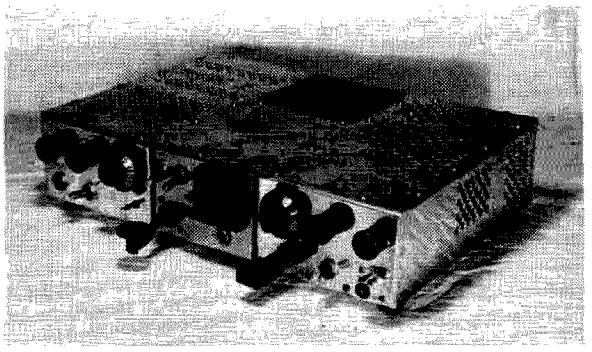
Wayne, OM,

I'm a fumbling amateur, as dumb as dumb can be. Many of my projects fail to work for want of proper knowledge. But I have inspirations as often as it rains—and a few of them **do** work. It's probability. The best skywire I ever had was a cubical quad—I made it to the measurements printed in the book. That thing could hear a gnat sneeze in Mongolia—if pointed that way; the side pickup was down 30 db. It lasted 18 months, this bamboo windcatcher—'til a November gale bent the steel that held it vertical. Later came the circle quads, shaped of aluminum tubes. These were simply polished, 'sophisticated' versions of the quad. I tried one on ten, but in my fumbling way. It never acted as a beam—too many compromises in its framework. In recent months I've seen the helix touted for amateur use. The helix shows 'handedness,' which the quad never did, so is useless if the other guy is a southpaw. Too, in this tracking jazz, a signal shows 'rotation' effects when it travels through a layer of free ions. The Oscar signal is all screwed up when it reaches our waiting wires. The only logical **efficient** antenna for adequate reception of Oscar signals is a completely impartial quad-ty-e antenna. I've scanned the literature with a microscope, but have found no mention of any attempt to adapt the quad to high-gain configurations. Wayne, am I missing something—like maybe a few buttons? Or is this an area that has been buried under the QRN of helices, etc ?

Bob Russ KϕGKI

Briefcase Twins

Sidney Rexford W2TBZ
Colton, New York



Three quarter view showing panel layout, built-in key, and ventilating holes on side and top of the chassis. The relatively symmetrical layout gave the unit its name.

WHILE I may be classified as a dyed-in-the-wool fone man, the old CW bug occasionally bites and the only solution is to work away on the nasty stuff until the spell passes and sanity returns. In the middle of an unusually mean attack it became evident that the station CW setup was as antique as high button shoes and something needed to be done about it.

The more the problem was studied the more it began to look as if a small self contained CW transmitter and receiver would be an ideal answer to the problem. If it was small enough and portable enough several other pipe dreams could be realized too.

A rather imposing "Want List" was prepared of the desirable features a small CW rig should possess. It went like this:

1. *High Portability*—To fit in a briefcase if possible. This limited dimensions of the container to about 3" x 10" x 14".

2. *Self Contained* — To include everything necessary for operation except an antenna and a 110 volt AC wall socket.

3. *Full CW Coverage* — Of the transmitter and receiver of some popular band "Open" during civilized times of the day—preferably 40 Meters.

4. *Rugged Reliability* — Must be conservatively designed and built with components operated well below critical levels to reduce maintenance and repair problems.

For those who question why the little rig was not designed around a transceiver circuit, I hasten to add that the idea was given considerable thought before being discarded. The chief argument against a transceiver circuit is the fact that retuning the receiver to duck QRM moves the transmitter frequency too and with the low transmitter power it is reasonable to assume that the guy on the other end of the QSO will have his receiver selectivity screwed up so tight that a small shift in frequency could easily put the signal outside his band pass and lose the QSO.

With the exception of the built-in key and the non-standard power transformer the parts are standard and easily obtainable. While this article isn't designed to provide the reader with much more than the impetus to take the soldering iron in hand and whomp up his own "Briefcase Twins" for his favorite band, this rig probably could be duplicated right down to and including the built-in key by some hardy souls. This built-in key came from a surplus water-tight knee bracket job with no identification other than "BRELCO NY" in raised letters on top of its water-tight box. The key mechanism was removed from the box and mounted in a ¾" hole as shown in the photos. Key adjustments are accessible through holes drilled in the bottom of the chassis.

Key to Key

The little rig provided an opportunity to try out a somewhat novel keying circuit which proved highly successful and is worthy of duplication in any future CW transmitter design.

Sequential keying is not new. There are several circuits available all of which are successful and widely used. Most of them I have tried resulted in satisfactory keying of the transmitter but failed to properly mute the receiver, provide monitor facilities, and provide

for antenna switching without an annoying clatter. What was desired was an automatic circuit that would do all of these little chores and do them the first time the key was closed, then undo them after keying was completed. This would provide clean keying characteristics and still permit a reasonable break-in capability.

The basic keying circuit is shown inside the dotted lines of Fig. 1. The mode of operation may not be apparent at first glance so a few words of explanation are in order. For the explanation assume a jumper between H and I.

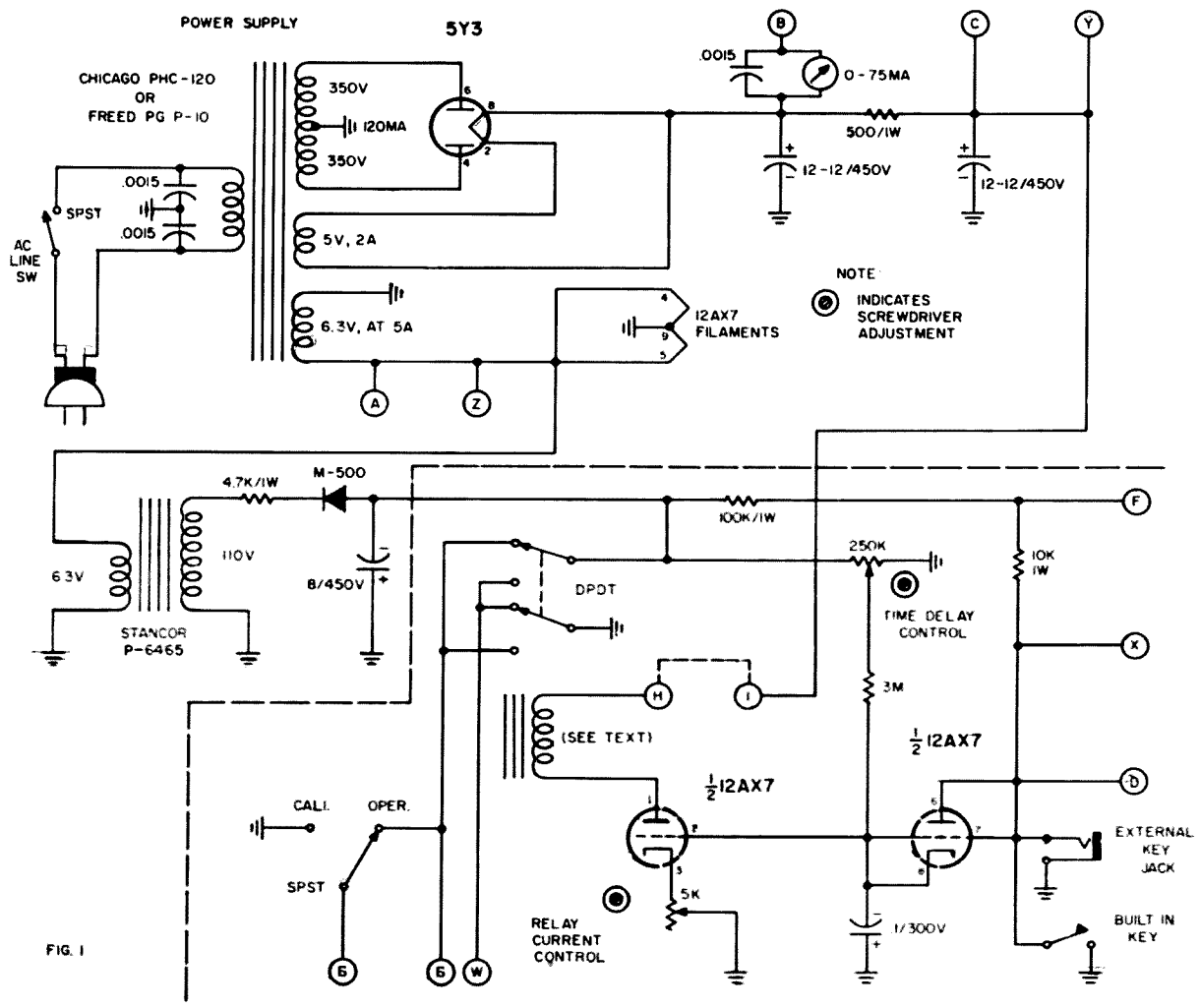
With the key open −150 volts of blocking bias is applied to the final amplifier grid and the monitor oscillator. The diode connected half of the 12AX7 does not conduct because negative (or equal) voltage is applied to the plate with respect to the cathode. The .1 mfd capacitor between the cathode and ground is charged negatively above ground through the 3 Megohm resistor. This negative voltage is also applied to the grid of the second half of the 12AX7 biasing it beyond cutoff leaving the plate relay open. No bias voltage appears on the receiver tube grids and the receiver operates normally. Disabling cutoff bias is applied to the transmitter grids.

When the key is closed cutoff bias is removed from the monitor oscillator and normal operating bias of −15 Volts is applied to the

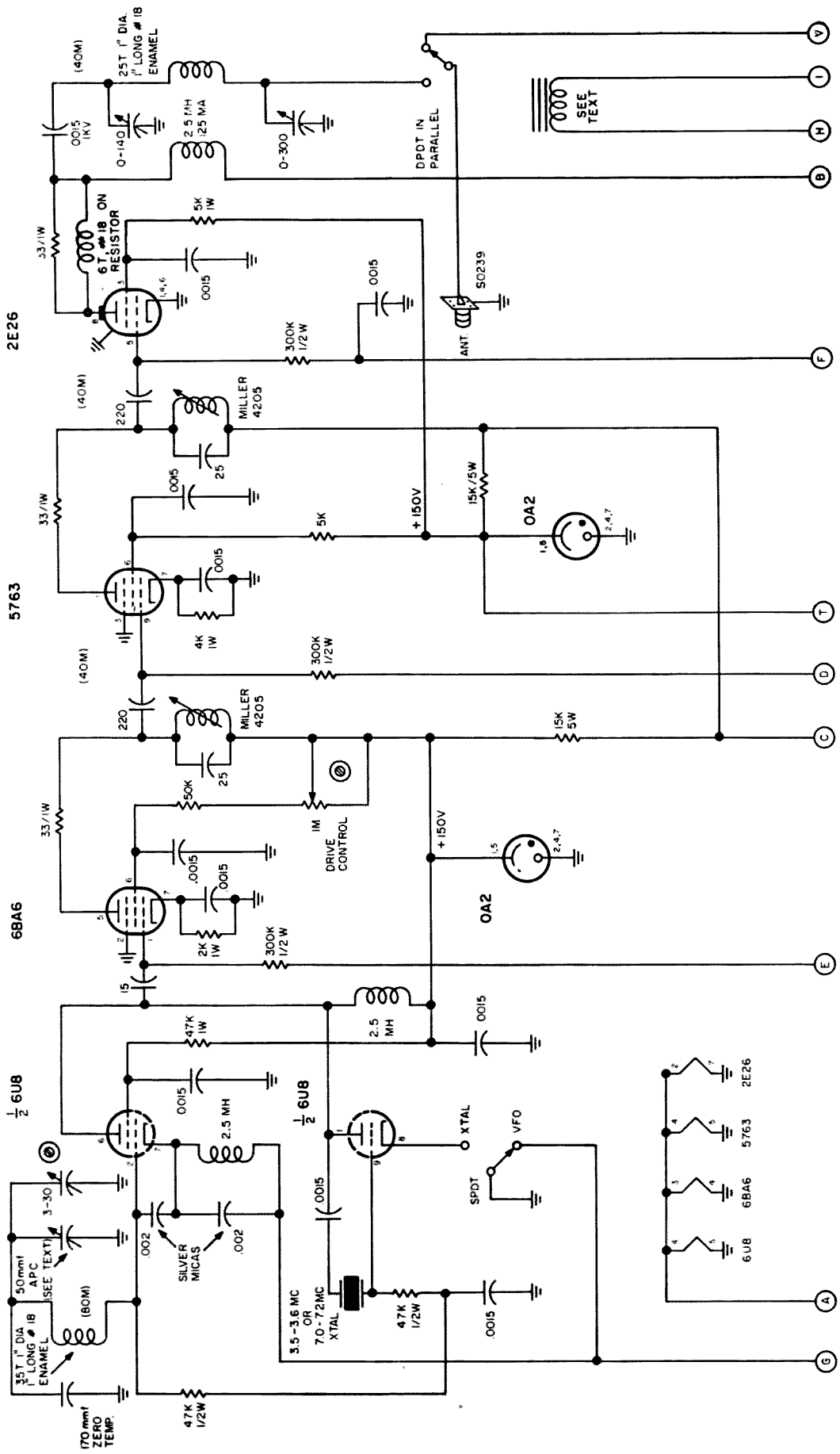
Fig. 1

NOTE: The voltages measured at the circled points will depend upon the transformer used. The table values given are approximate, and measured from point to chassis.

Voltage Point	Voltage Key Up	Voltage Key Down
A	6.3vac	6.3vac
B	+400v	+400v
C	+400v	+390v
D	−150v	0
E	−150v	0
F	−150v	−15v
G	−150v	0
H	+400v	+300v
I	+400v	+390v
W	0	−150v
X	−150v	0
Y	+400v	+390v
Z	6.3vac	6.3vac

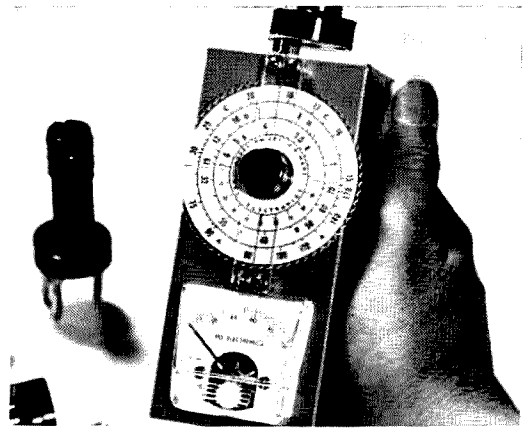


KEYER CIRCUIT



NOTE: All by-pass capacitors are 600v disc ceramics unless otherwise indicated.

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final amplifier grid. The plate of the diode connected half of the 12AX7 appears positive with respect to the cathode; the tube conducts and quickly discharges the .1 mfd capacitor. This removes the cutoff bias from the grid of the relay tube half of the 12AX7. Plate current flows and the relay closes. When this DPDT relay closes cutoff bias is removed from the transmitter oscillator, permitting it to operate. At the same time cutoff bias is applied to the receiver tube grids muting all but the af portion of the receiver.

During normal keying speeds the .1 mfd capacitor is discharged each time the key is closed. The time constant of charge of this capacitor through the 3 megohm resistor is relatively slow and cutoff bias for the relay half of the 12AX7 does not have time to develop between characters. When normal keying ceases, and after a short delay, the .1 mfd capacitor will charge sufficiently to cut off the plate current, the relay to open and the cycle is completed.

Since it is also desirable to change the antenna from the transmitter to the receiver whenever the receiver is in operation a second relay for this purpose has been located near the antenna connection in the transmitter chassis. Two electrically identical relays are placed in series to perform both of the required functions. It was found that one relay opened a fraction of a second earlier than the other. The relay that opened first was chosen for the antenna change-over relay. This prevented an additional snap in the receiver by connecting the antenna before bias was removed from the receiver grids. This relay was not designed to handle rf but with this frequency and power level it works well and no future trouble with it is anticipated. Any relays capable of operating on 15 ma or less will do the job. The relays used closed on about 9 ma of plate current even though they were marked 5600 ohms and 110 Volts dc operating voltage.

The driver, final amplifier and keying monitor oscillator, being divorced from the relay all key in a normal blocked grid manner. Stations worked report the keying to be completely free of clicks, tails, chirps or other keying ills at any speed. With a bug plugged into the external key jack, and the weights off keying is still faultless. The first dot from the wide open bug is enough to set the whole keying circuit in operation and put rf into the antenna. This is better performance than was expected.

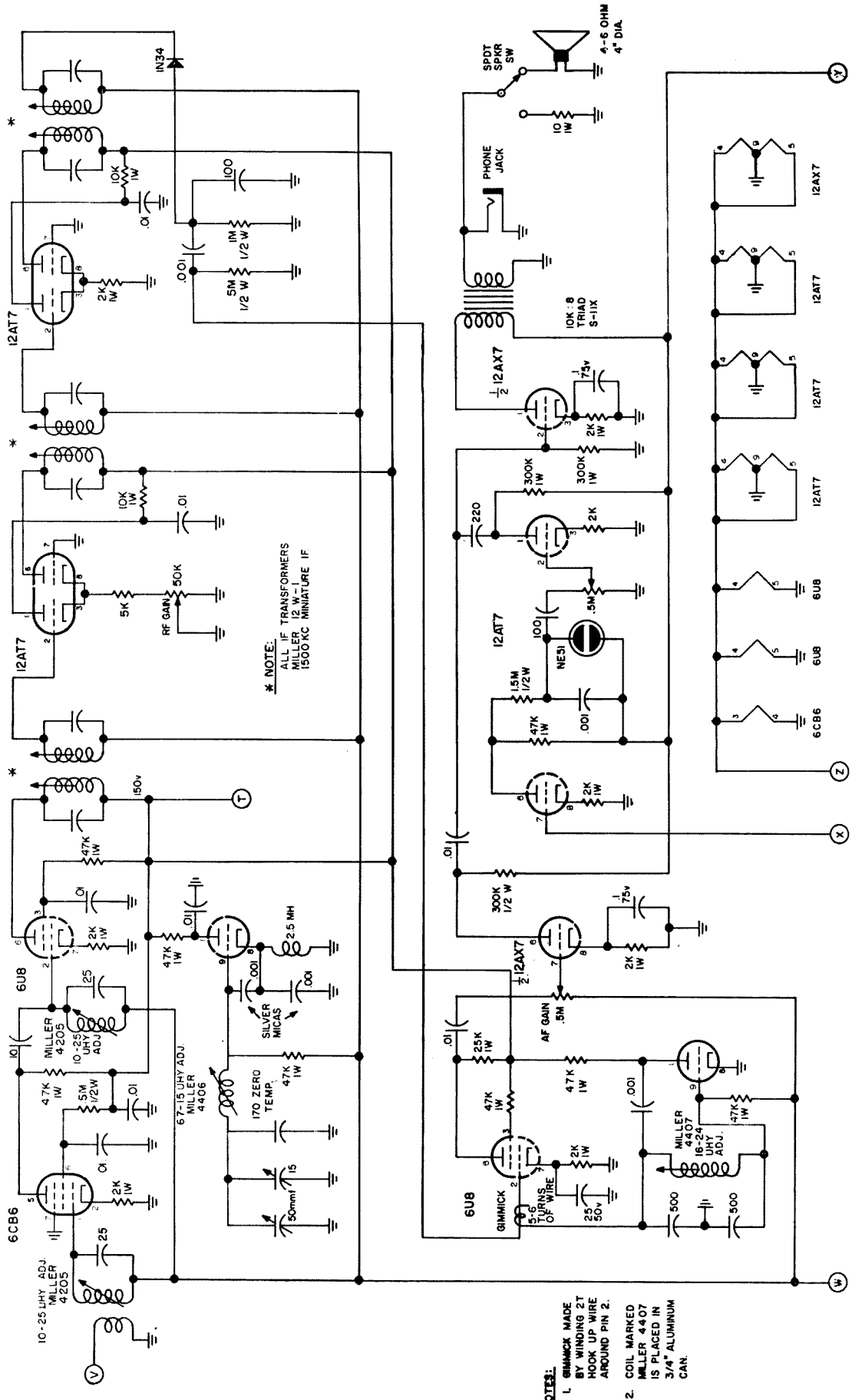

RECEIVER
12AT7
6U8
6CB6
12AX7
1N34
SPDT SPKR SW
4-6 OHM 4" DIA.
PHONE JACK
10K:8 TRIAD S-11X
RF GAIN
AF GAIN
SILVER MICAS
170 ZERO TEMP.
GIMMICK
5-6 TURNS OF WIRE
MILLER 4205
MILLER 4406
MILLER 4407
* NOTE: ALL IF TRANSFORMERS MILLER 12 W-1 1500 KC MINIATURE IF
NOTES:
1. GIMMICK MADE BY WINDING 2T HOOK UP WIRE AROUND PIN 2.
2. COIL MARKED MILLER 4407 IS PLACED IN 3/4" ALUMINUM CAN.

FIG 3

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¾ watt 20% 8.5piv	1.15
¾ watt 20% 15. piv	1.15
¾ watt 20% 22. piv	1.15
1 watt 20% 4.3v	1.35
1 watt 20% 6.2v	1.35
1 watt 20% 8.5v	1.35
1 watt 20% 15. v	1.35
1 watt 20% 22. v	1.35
Double anode 6.3v ±20%	.50

TRANSISTORS

Similar CK721, CK722, CK786	2 for 60¢
PNP repl'm't 4-trans radio	2.10
PNP repl'm't 5-trans radio	2.45
PNP repl'm't 6-trans radio	2.75

DIODES

	10 for
Germon'm replaces 1N34A	$0.98
Similar 1N137, 1N137A, 1N138, etc.	1.20
Gen. purp, glass silicon	.98
R-f gen. purp replaces 1N82A ..	.98

RECTIFIERS

100ma	1000piv hi-V silicon	$1.70
100ma	1500piv hi-V silicon	2.25
100ma	2000piv hi-V silicon	2.95
100ma	3000piv hi-V silicon	4.45
500ma	200piv epoxy, sim. 1N2069	.30
500ma	400piv epoxy, sim. 1N2070	.40
500ma	600piv epoxy, sim. 1N2071	.70
750ma	50piv replaces 1N599	.11
750ma	100piv replaces 1N600	.20
750ma	200piv replaces 1N602	.33
750ma	300piv replaces 1N603	.39
750ma	400piv replaces 1N604	.48
750ma	500piv replaces 1N605	.60
750ma	600piv replaces 1N606	.75
750ma	700piv —	.95
750ma	800piv —	1.25
750ma	900piv —	1.50
750ma	1000piv —	1.95
750ma	1500piv —	3.25
750ma	2000piv —	4.15
2amp	50piv replaces 1N2026	.17
2amp	100piv replaces 1N347	.30
2amp	200piv replaces 1N2027	.45
2amp	400piv replaces 1N2029	.90
2amp	600piv replaces 1N2031	1.35
2amp	800piv replaces 1N1236	1.75
2amp	1000piv replaces 1N3366	2.90
2amp	1500piv replaces 1N3371	4.70
2amp	2000piv —	6.50
2amp	Cont. Rect. similar 2N1600	3.50

RECTIFIERS

2amp	50piv axial lead	$0.15
2amp	100piv axial lead	.27
2amp	200piv axial lead	.40
2amp	400piv axial lead	.85
2amp	600piv axial lead	1.20
2amp	800piv axial lead	1.60
2amp	1000piv axial lead	2.80
2amp	1500piv axial lead	4.30
2amp	2000piv axial lead	6.00
12amp	50piv replaces 1N1199	.75
12amp	100piv replaces 1N1200	1.20
12amp	200piv replaces 1N1202	1.75
12amp	400piv replaces 1N1204	2.60
12amp	600piv replaces 1N1206	3.75
12amp	800piv —	6.90
12amp	1000piv —	9.50
20amp	to 400 piv. Cont. Rect.	14.00
25amp	50piv replaces 1N248A	1.50
25amp	100piv replaces 1N249A	2.50
25amp	200piv replaces 1N250A	3.70
25amp	400piv replaces 1N2136A	4.75
25amp	600piv replaces 1N2138A	7.75
25amp	800piv —	10.00
50amp	25piv —	2.70
50amp	50piv similar 1N4118	3.98
50amp	100piv similar 1N4128	5.98
50amp	200piv similar 1N4138	6.50
50amp	400piv —	9.75
50amp	600piv —	16.00

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Power Supply

The Twins are built in two standard 3″ x 5″ x 10″ chassis joined together in the center by the power supply and keyer chassis which is 4″ x 5″ x 6″ with an outboard power transformer projecting out the rear which extends its overall length to about 10″. The front end of the chassis becomes the panel and contains the ac switch, the transmitter calibrating switch, the 0-75 ma plate meter, the built-in key and the external key jack. The circuit diagram is shown in Fig. 1.

The power supply chassis was constructed first and was by far the most difficult of the three to wire. To anyone considering construction of such a piece of gear I recommend shopping around for physically small components. Being a natural born cheap-skate I used what was in the junk box as long as it could be fitted in without resorting to too big a hammer.

As much wiring as possible was made before the chassis began to get too full. Leads to what were to become inaccessible points when subchassis and brackets were installed later were brought out and carefully tagged. It is a good idea to prepare a step by step construction guide, Heathkit style, by mentally wiring the unit several times before final construction is undertaken. Brackets containing the filter capacitors, the keyer tube and its relay, and the rectifier tube were prewired and inserted in that order. Each wiring step was carefully checked for accuracy before progressing on to the next.

It is a good idea to take stock of the interconnections going from the transmitter to the receiver chassis which must pass through the power supply chassis but not stop along the way. The chore of trying to fish them through later can be most exasperating.

The 5000 ohm variable resistor in the cathode relay tube half of the 12AX7 provides for adjustment of maximum relay current. It is adjusted by holding the key down and reducing its resistance until both relays close. The 250,000 ohm potentiometer provides for adjustment of the time delay length. If maximum available delay is not sufficient for your taste the 3 megohm resistor may be increased to 4 or 5 megohms.

The power transformer used was a surplus Hallicrafters 52 C 243 made by the Chicago Transformer Company. The transformer has two 110 volt primary windings, one of which was pressed into service to provide the −150

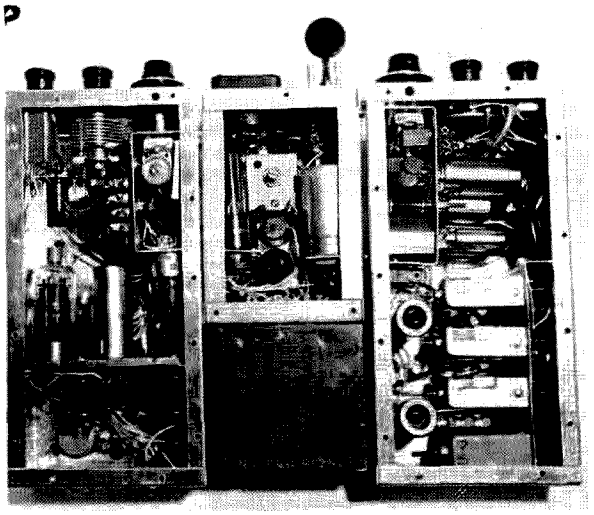
volt bias source. Fig. 1, however, shows a back-to-back filament transformer for this purpose. This is to preclude frustration of builders who cannot locate an exact duplicate of the transformer I used. Those who run into space problems may relieve the congestion by substituting silicon diodes for the 5Y3 rectifier tube.

In the construction of the power supply chassis three ½", #6-32 bolts were installed on each side to fit matching holes in the receiver and transmitter chassis and provide for future alignment. These bolts later become inaccessible in both the receiver and transmitter so no effort was made to bolt the complete unit together.

Transmitter

The transmitter was the second chassis constructed and wired. The circuit, shown in Fig. 2, could have been made much simpler and with fewer stages but I doubt if it would have worked nearly as satisfactorily. About three volts of signal is provided by the vfo while a forty meter crystal provides in excess of twenty volts. The high values of grid resistors in the 6BA6 and succeeding stages provide limiting action and uniform drive to the grid of the 2E26 final amplifier. This keeps operation in the class AB_2 region throughout the entire band and regardless of the amount of drive provided by the vfo or crystal used. Class AB_2 is only slightly less efficient than class C operation and results in an exceptionally clean signal. No hint of TVI can be found.

The front panel controls of the transmitter consists of a tiny Japanese import vernier for the vfo, a crystal socket, a switch to choose between the crystal and the vfo, final tuning, antenna loading and an SO-239 coax connector for the antenna.



Internal view showing placement of parts and general location and size of brackets and subchassis.

The complete layout of tubes, voltage dropping resistors and other heat producing components was determined and ventilating holes drilled in the bottom, rear and right side of the chassis. Areas for the ventilating holes were squared off in ½" squares and ¼" holes were drilled in each corner and the center of each square. *Don't be skimpy on the ventilating holes!* The bull work necessary to drill a couple of hundred of them will really pay off in stability later on. You lazy guys might try using squares of "Reynold's Do-It-Yourself" perforated aluminum sheet bolted in place. It's a little thin for the job but presents an easy out.

The oscillator sub-chassis was installed and tested first. Coverage of the vfo was adjusted by removing plates of the 50 mmfd APC tuning capacitor until 3.5 mc to 3.6 mc covered approximately an area between 1 and 9 on the vfo vernier dial. After doubling in succeeding stages of the transmitter this permits coverage of the 40 Meter CW band from 7.0 mc to 7.2 mc.

The second subchassis constructed, prewired and inserted contained the rest of the transmitter tubes and the rf choke for the final amplifier plate circuit. Considerable thought must be given the layout of this chassis with particular attention to being able to remove and replace tubes later and to adjust tuning slugs without tearing the whole shebang apart.

A small L bracket under the antenna loading capacitor accommodates the antenna change over relay.

Plate current on the completed final amplifier rises to about 50 ma off resonance and gives maximum output when loaded to about 35 ma. Loading above the 35 ma level results in loss of output. Once the stages are all aligned at about 7.1 mc, the entire band can be covered with only minor touching up of the final tuning.

Receiver

The receiver front panel controls consist of a Japanese import vernier for tuning, an *if* gain, af gain, phone jack and speaker switch. Access of the Clapp oscillator tuning slug is also available under the tuning vernier. The panel as can be seen from the three-quarter photo is a mirror image of the transmitter control layout. As any fool can plainly see, that's where the "TWINS" comes from.

Construction of the receiver, shown in Fig. 3, produced far more headaches than had been anticipated. If its construction was to be under-

taken again some different techniques would be employed. Let's see what actually was done and what changes would be made.

Ventilating holes were liberally drilled in the receiver chassis bottom, rear and left side. The same system was used as was employed in the transmitter. Similar holes were drilled for the speaker which was located in the front bottom of the chassis. The speaker, an 89 cent 4-8 ohm, 4" diameter job of unknown manufacture, output transformer and phone jack were installed and wired together before the other sub-chassis was installed.

The second chassis contained the audio amplifier and keying monitor. Small values of coupling capacitors and cathode by-passes tailor the audio output to peak around 1 kc. No trouble with the audio portion was experienced but the relaxation type keying monitor oscillator proved critical and the chassis had to be removed and the values of the circuit changed to obtain proper operation. Builders of this monitor circuit may have to juggle components slightly to achieve a pleasing note. If the area underneath this sub-chassis is cut out of the main chassis so that access can be made available, the wiring changes of this nature can be made without removing the entire assembly. The cutout can be covered with a perforated plate held in place with self-tapping screws.

The *if* stages, bfo and detector circuits were assembled and installed next. This portion of the receiver produced all of the headaches and the sub-chassis was removed and worked on a dozen times before satisfactory operation was achieved. Again a plate covering an access hole on the left side of the main chassis would prove a godsend.

The receiver front end was designed around the tried and true "Converterette" circuit published several years ago in CQ. Receiver coverage was adjusted to correspond roughly to the same vernier dial readings as the transmitter by removing plates from the tuning capacitor. The only precaution necessary is an adequate shield between the rf and mixer tuned circuits. No trouble was anticipated or experienced with this portion of the receiver.

The selectivity of the 1700 kc *if* strip, while not considered inadequate, could be improved by the addition of a crystal filter preceding it. The crystals intended for the job were found to be sour so the filter was by-passed temporarily. Adequate gain in the *if* strip is available to take care of the filter insertion loss. Without it the rf gain is normally run at minimum. Anyone contemplating the design of a similar receiver would do well to consult "Phasing for Audio Selectivity" by Jim Kyle, K5JKX/6 in the November 1961 copy of 73. This little device would go a long way toward increasing selectivity and, if built in as part of the af amplifier, might eliminate any need for a crystal filter and permit one stage of *if* to be eliminated.

All brackets and sub-chassis were hacksawed from an old aluminum bottom plate. The garden variety of "Do-It-Yourself" aluminum sheet is a little too thin and flimsy for the job but probably could be used.

The internal photo shows the general interweaving of components mounted on the various sub-chassis and brackets. Tubes are placed under the *if* cans in the receiver and are so arranged that all tubes can be removed without having to remove any complete assemblies although some tubes from other assemblies must be removed first.

Screwdriver adjustments are accessible underneath the unit and through holes in the cover plate and sides of the receiver chassis.

The cover plate was cut from one piece of sheet aluminum and installed with self-tapping screws. It offers the main "stiffening" tying the three chassis together. A short strap, bridging the three chassis, across the bottom finishes the stiffening job.

Rubber feet in each corner of the completed rig prevents marring the furniture and keeps the womenfolk happy.

The "buttoned up" rig becomes mechanically stable and can be picked up and shook vigorously without changing the note of the receiver or transmitter. Drift is noticable for about twenty minutes then both units stabilize satisfactorily. The mistake of laying the log book on top of the rig and shutting off ventilation through the holes will prolong the drift indefinitely.

The entire rig weighs 12½ pounds. With its built-in key and monitor oscillator it becomes an ideal unit for providing code practice or for giving Novice code examinations. The note from the monitor compares favorably with most code practice oscillators on the market. Design of the transmitter circuit precludes damage to the rig because of failure to tune the final to resonance or operation without an antenna.

The first afternoon of operation into a run-of-the-mill doublet bagged seven states from the Sunday QRM with an average report of 569X. Which only proves that they will never know that you are a QRP if you don't tell 'em!

. . . W2TBZ

A Ham Looks at the

Heath Warrior

Don M. Wherry W6EUM
2121 Grandview Drive
Camarillo, Calif.

A RECENT EXAMINATION of the QSL cards received here at W6EUM during the past two years revealed an interesting fact—for the cards received, over 44% of the stations involved used some model of Heathkit transmitter. This fact struck your writer with some little impact. There must be some reason for such a situation and since he does possess a well known 140 watt SSB transmitter, the decision was made to look into it by the purchase of a Heathkit Warrior Linear Amplifier.

This article is an attempt to review this Warrior as Joe Blow ham might see it and not necessarily as an advertising agent for the Heath Company might.

When you, as the purchaser, receive the unit you will be impressed by one thing—it is heavy (shipping weight 99 pounds). This would immediately indicate rather solid construction and, upon unpacking, this belief is verified. The chassis is made from heavy gage steel, the panel and cabinet are solid construction and the transformers, while not oversize, seem to be adequate. The chassis, in fact, is outstanding in its solid, heavy construction. It is made in two parts, the sides and the top, with the top, for example, bolted to the sides with twenty-two machine screws and nuts. Not self tapping screws, but 22 machine screws—shades of military equipment.

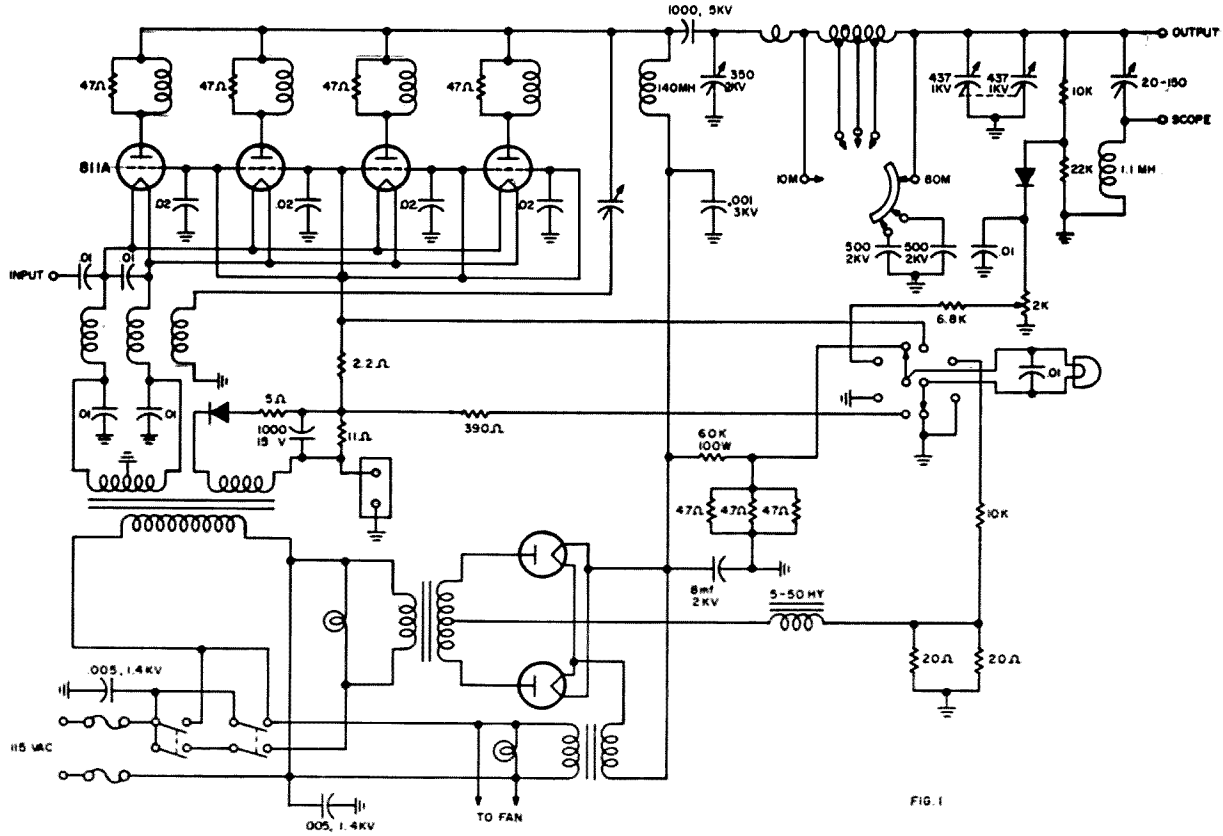


FIG. 1

The general parts, condensers, resistors, tubes, etc., are standard quality brands—RCA, Johnson, etc. No attempt at all was made to cut financial corners on parts.

The mechanical assembly was straightforward and offered no difficulty with but two exceptions. One machine screw holding the rf shield around the rf section was quite inaccessible, taking the special nut starting tool which they furnish, and the use of long nose pliers to start. The second exception was a little more serious. The front panel has two indicator light assemblies which go through the front escutcheon plate, the front panel and on through the chassis. In my unit the holes in the three pieces were not quite in line which necessitated a few judicious swipes with a round file. The material filed off probably amounted to only a couple thousandths of an inch, but if the assembly doesn't go together it might as well be an inch.

Electronically the circuit is a standard grounded grid linear amplifier. The drive is applied via a 50 ohm co-ax directly to the filaments of the four 811A tubes. The rf is coupled to both sides of the filament through disc ceramic capacitors. The rf choke in the filament leads is physically quite small—by B and W standards—and consists of a bifilar winding about 2½ inches long by 1 inch in diameter, wound around an iron core which apparently is made of normal slug material. The interesting part of this assembly is the feedback winding which is spaced over the filament portion and is connected in series with a neutralizing condenser to the plates of the 811A's.

The unit is very easy to drive, their statement of 50 watts needed to drive it to a full KW seems to be a perfectly safe statement if a reasonable SWR is present in the output co-ax. No exact measurements were made but on the lower frequency bands a full gallon was possible at something less than 50 watts. This is output from your exciter, of course, and not input. An input of around 75 watts seems to be a safe minimum figure. Of course if your exciter is a little short on power you can drive it to something less than a KW. It will operate fine at 700 watts, for example, with considerable less than the rated drive for a KW.

The plate circuit is also normal. Good symmetry is practiced around the four 811A tubes, each of which has their small parasitic suppressor mounted in a symmetrical setup. The tank coil is made of good size wire and appears to be adequate—especially the 10 meter coil which is heavy copper tubing. The band switch could be a little heavier. It looks a little small for a KW but again it works fine and in view of the low plate voltages used (1400 to

500 Watts PEP!



Complete transmitter, including heavy duty power supply.

Features

Upper and lower sidebands on all ranges
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VFO Stability: 50 cps. after one-half hour warmup
Pi network output. 45-100 Ohms
Voice control
Anti-trip circuitry

Frequency Ranges: 3.5-4.0 mc, 7.0-7.5 mc, 14.0-14.5 mc, 21.0-21.5 mc, 28.0-28.5 mc, 28.5-29.0 mc, 29.0-29.5 mc.

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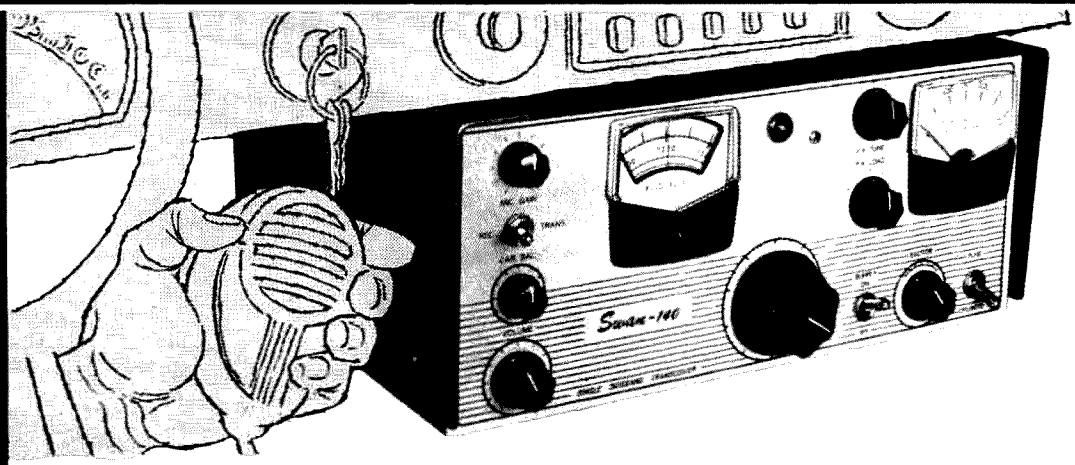
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1600) this is not really a serious problem. The contact spacing is good so no danger of rf arcing is present, especially since the peak voltages under SSB or CW are not nearly as severe as those with a KW using AM modulation.

The standard pi network is used for the output tank circuit. The ability to match an antenna load of 50 to 75 ohms is advertised and is a conservative figure. No loading problem should exist with any tolerable SWR in the feed co-ax.

An interesting adjunct to the rf output circuit is a small condenser and an rf choke from the output line to the ground. The midpoint is brought out to a small jack on the rear chassis apron for use as a feed for the vertical deflection plates of your scope—or your vertical input amplifier if your scope has good enough frequency response. This will allow you to watch your scope and get some indication of your modulation characteristics. It may not be exactly a laboratory method for modulation monitoring but it does help.

The neutralizing system, as mentioned earlier, uses a variable condenser from the plates of the 811A tubes, through the condenser to the coil which is wound around the filament choke to the ground. The neutralizing process is described in the manual as simply spacing the condenser plates a prescribed distance apart. This seemed to be a very rough way to neutralize and some doubt existed in my mind as to the effectiveness of this method. However, upon operational test the amplifier is perfectly stable with no indication of regeneration on any frequency.

The metering system measures the grid current, plate current, relative power output and the high voltage. This is indeed fine—these are exactly the things the operator should know. The tendency of modern transmitter manufacturing concerns to simply meter the relative power output leaves me cold. For the added price of a switch and a few resistors it seems that the policy of metering only the output is very ill advised. I am of the opinion that the prime reason it is done that way is to conceal the fact that a fixed loading circuit does not always load your final the way you might wish. How many of us have a perfect 1::1 match to our antenna?

The bias supply is taken from a special ten volt winding on the filament transformer, half wave rectified, filtered and bled through a 5 ohm and a 11 ohm resistor. The voltage for the tube grids is taken from the junction of these two resistors and is very stiff, being held very

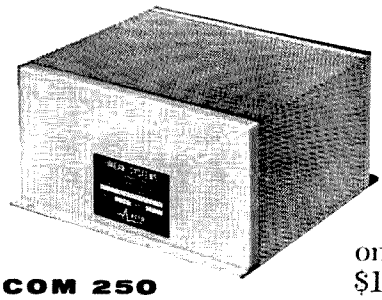
close to the 4.5 volts desired when under modulation. The grounded end of the bias supply is brought out to a terminal board on the rear chassis apron where it may be grounded directly or placed in series with an external (or internal for that matter) voltage of approximately 50 or more volts to furnish cutoff bias for standby or "no modulation" conditions. This is desirable because some modern exciters generate a hash while in the "on" status but with no output, such as is the case when no speech is present on SSB or the key is "up" on CW. This hash may be amplified by the final amplifier when it is not in a cutoff condition and can be very annoying. Odd as it may seem this hash, which another commercial rig of mine does generate to some extent, did not seem to get through the Warrior, even when only the normal 4.5 volts were used. In any event the addition of some VOX controlled external bias can remedy such a condition easily.

Now, while we are on the subject of bias let me digress from the original theme of this article for a moment and describe a modification which can be placed in the amplifier to furnish this cutoff voltage. Don't turn the page as this modification does not require alteration of the original amplifier, but only an addition. In other words if you might wish to sell the unit at some later date you can return it to its original condition easily and quickly.

Fig. 2 shows a bias and switching arrangement which can be added to the linear to furnish cutoff bias and/or higher operating bias for class C CW operation. The small power supply in the unit furnishes voltage for the cutoff bias and for energizing the control relay —providing a low current plate relay is used. In case an ac relay is used omit R18 and bring out both coil leads as described later in Step 8 of the construction notes. This bias supply and relay will allow several transmitter conditions to exist i.e. 1) by connecting a jumper on the outside of the chassis from terminal 1 of T to the ground terminal on the chassis, normal operation of the amplifier will result regardless of the condition (open or closed) of relay Ry 1, 2) by grounding terminal 2 of T and actuating the relay for transmit, cutoff bias is applied for standby and the normal voltage of 4.5 volts is applied for transmit, 3) by removing jumper from T and actuating relay on transmit a cutoff bias is established for standby and a high operating bias is established for class C CW service, 4) by shorting terminal 1 and 2 of T and not actuating the relay a condition of no cutoff standby bias is established and a high operating bias for class C CW is established. These

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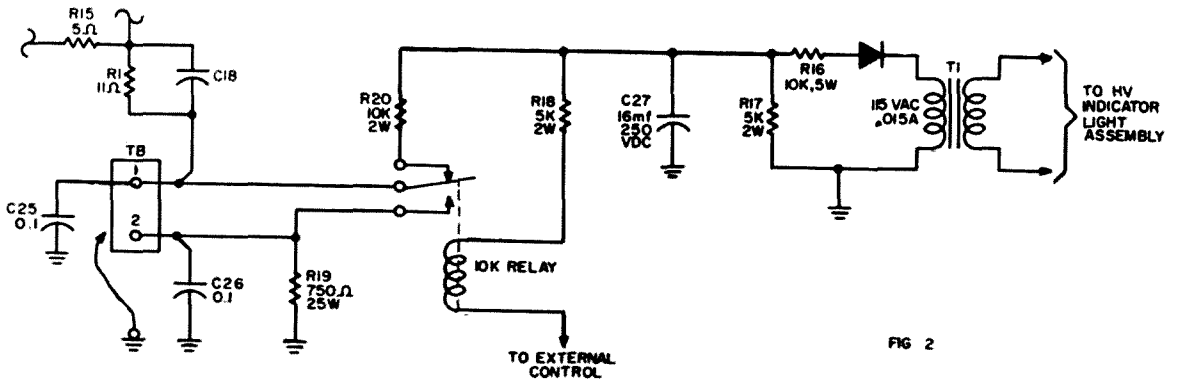


FIG 2

four bias situations will cover any normal operating need and the unit, as can be seen later by the installation instructions, can be easily removed at some later date if desired.

A step by step method of constructing and mounting this unit is given here—

Step 1 Bend an aluminum bracket as shown in Fig. 3. Mount under the nut that holds HV indicator light as indicated.

Step 2 Build circuit shown in Fig. 2. Suggest using printed circuit board or a piece of bakelite. Mount on bracket of Step 1.

Step 3 Remove ground from terminal 2 of terminal strip T and connect a 0.1 ceramic capacitor in its place.

Step 4 Connect center arm of relay to terminal 1 of terminal strip T.

Step 5 Connect normally open contact of relay to terminal 2 of T. Keep wire for step 4 and 5 clear of filter condenser terminal NN2.

Step 6 Connect primary of power transformer in parallel with HV indicator light.

Step 7 Fabricate jumper wire 7½ inches long and connect one end to ground lug on rear of chassis. Put spade lug on free end of this jumper. Use this jumper to ground either terminal 1 or 2 of strip T as described earlier.

Step 8 Bring out free wire from relay coil to outside of chassis by running through same grommet as 115 VAC power wires.*

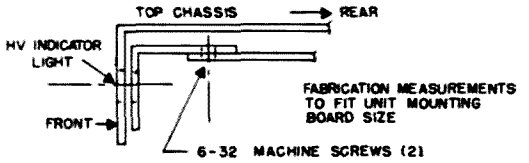


FIG 3

Step 9 Connect 0.1 ceramic capacitor from terminal 1 of T to terminal 2 of terminal strip TA.

Step 10 Cut wire 3 inches long and put spade lugs on each end. To be used to short terminals 1 and 2 of terminal strip T when amplifier is to be used with no standby cutoff bias and with high operating bias for class C CW.

This completes the modification. Now of course this small unit can be mounted on a separate chassis and wired to the outside of terminal board T but it makes a cleaner job to do it on the inside. The relay of the unit can be connected to the VOX circuits of your exciter to be turned on or off with the antenna relay, receiver quieting, etc. If you use an ac relay for your antenna changeover switch it might be advantageous to use and ac relay in the unit and parallel it with the antenna one. Each individual case might be a little different.

Enough for the bias—the power supply is normal except for a slight novelty regarding the choke and power transformer—both which have very large cores. This, perhaps, was to allow fewer turns per volt on the windings and allow larger wire per given voltage. The choke is a swinging type which goes from 5 to 50 henrys, which is quite a swing. Both the power transformer and choke run at a normal warm temperature under both SSB and CW operation—in fact somewhat cooler than was expected or is the case in some other commercial equipment. One other interesting feature of the power supply is that of the switching. The transmitter has two switches—one to turn on the filaments and one to turn on the high voltage. This is to allow the filaments to heat up before the high voltage is applied. The interesting feature is that it does not make any difference which switch you turn on first; the filaments light first. This means that if you make a mistake in turning on the switches you still turn on the filaments first. They are marked Fil

Note * — If an ac relay is used instead of the plate type run both leads from the coil out with the 115 vac.

and HV of course, for those of us who watch what we are doing.

Double shielding is used—the rf section is in its own shielded enclosure which is mounted on the chassis and then the cabinet forms a good shield for the overall unit.

No special TVI precautions were practiced except for the good shielding. A linear running a little on the A side of class B is not much of a harmonic generator so if your exciter is clean your TVI should not be too much of a problem. In case you use the higher bias for class C CW you might run into more of a TVI problem but usually they can be cleaned up with enough effort. Also in the real fringe areas the problem of high power overloading nearby TV receivers will present itself but a good high pass filter on the receiver antenna input will cure that.

The unit comes with the cabinet painted a deep green. The escutcheon on the front panel is a matching green with the panel itself a light grey with a slight green tinge. It's real pretty—if you like green.

To summarize, it seems to your reviewer that Heath has done a very commendable job here—it's a lot of transmitter for $229. The only wish here is that it could have been packaged a little smaller. Nothing about it is on the "skimpy" side, the operation is everything a KW should be and it really puts out a signal. This linear, if it's indicative of the rest of the Heath transmitting line, perhaps explains that 44% noted earlier.

. . . W6EUM

Parts List

R1 —part of original unit
R15—part of original unit
R16—IRC 10K 5 Watt
R17—IRC 5K 2 Watt
R18—IRC 5K 2 Watt
R19—750 ohm 25 watt IRC type 2D
C25—Disc ceramic 0.1 ufd
C26—Disc ceramic 0.1 ufd
T1 —115 volt .015 selenium rectifier type
Relay—See notes

Letter

Dear OM:

Here is a list of my fellow Cubans who are using our hobby to spread communist doctrine from the Isle. CO1-AF, AH, GN; CO2-BG, BY, CF, CJ, CM, CR, CX, DL, DT, EU, FM, FV, GM, HT, IF, IG, IS, IT, JI, JL, KG, KI, KY, LD, LM, LT, MF, MN, MR, NP, OF, OM, PV, QQ, QS, QV, RO, RQ, RV, SF, ST, TW, VB, VH, VJ, VN, VO, WF, WU, XG, XI, XM, XN, ZL, NC: CO3-AG, BU, JD, MM, NR, PF: CO5-CG, CN, ER, FM, JA, JP, OF, PV, RB, RP, SA, TZ; CO6-AB, ED, FA, FB, GF, JC, KF, NV, PF, XZ: CO7-AI, CA, CG, HS, JM, LM, RQ, RS, RV, SL, SO, LG, FC, XW, JS: CO8-AL, BN, BO, CO, CP, CR, DL, DN, ER, ES, HG, HP, IC, LA, RM, SD. There are many more which we lack proof on so far.

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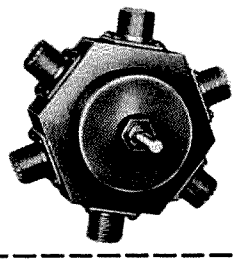
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Joe's Other World

WHEN she came in as usual to open the curtains to the early-morning sun, she knew this was to be no ordinary day. She made Joe comfortable, doing automatically for him the intimate jobs which had become so much part of her routine that it might have been a piece of her highly-polished furniture which she was putting in order. When he was clean and tidy, she gave him his breakfast, feeding him patiently, making occasional remarks about the weather and the news in the papers.

Usually he hung onto her every word in these moments of intimacy, for she was his only link with the world outside. But today she sensed his lack of attention, that he was thinking of something else. The meal over, she stood up.

"What time do you think they'll arrive?" he asked.

Deliberately she pretented puzzlement. "Who?"

"Fred and the boys, of course."

"Oh, sometime. Depends on whether they have finished it. Might not be today at all. Might be next week."

She felt an immediate flash of compunction, for he suddenly looked like a little boy who has been unfairly punished. But Em had never been a woman to give in to emotion or what she would have called "sloppiness." "I'll switch on the radio for you. There's a nice music programme."

She knew as the room filled with sugar-crested waves of Jerome Kern that Joe would have preferred a different kind of radio sound but it was in her power to decree what he should hear, at least for this morning.

Twice in the routine of the hours that followed she had to climb the stairs to answer his call. Had his friends phoned yet?

With bitter triumph she told him twice—no, there had been no call yet from the Radio Club.

Em was a good woman. For thirty years she had been a good wife to Joe, keeping immaculate the little house which they had been able to buy on account of her penny-pinching. Her cooking was famed for miles around, Joe's shirts were always spotless, his sweaters and socks hand-knitted in intricate designs. All their life she had saved money so that now, when their only income came from insurances and pensions, she was still able to maintain the house and their previous careful living standard.

Em even tolerated her husband's little weaknesses. Joe was allowed to smoke except, of course, in the parlour, whose velvet drapes and hand-embroidered cushions must on no account be sullied with the fumes of tobacco. The ancient refrigerator always had room for a can or two of beer.

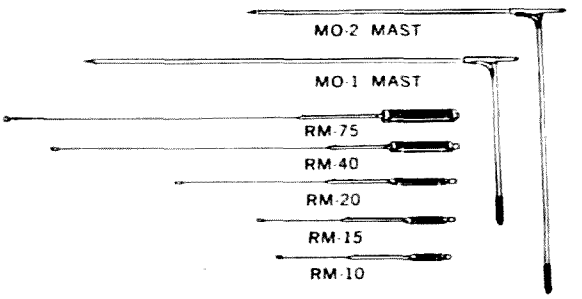
But one thing Em had fought all her life—Joe's other world, his hobby, his love for amateur radio. When they had first married she had given little thought to the ominous way he would spring to life, so to speak, when confronted with the load of junk in the attic. Like all young brides she had thought a few months of marriage would change him sufficiently to make him give up all that nonsense. But Joe, gentle and mild like so many big men, was remarkably obstinate on that point. He was hers, body and soul, except for the time he spent upstairs, producing unearthly sounds out of the junk and talking incomprehensible jargon to people thousands of miles away in whom Em had no interest at all.

Joe gave the major part of his wage-packet to his wife, keeping only a small sum for his own meagre expenses. But, by depriving himself of cigarettes and beer for nearly three years, he saved enough to buy himself a communications receiver which was the pride of his life. Em hated this interloper worse than if it were another woman come to break up their marriage. It came to represent for her the other world into which Joe escaped from her and into which she could never penetrate.

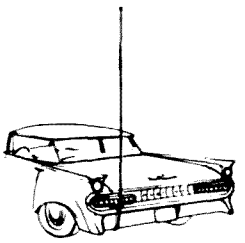
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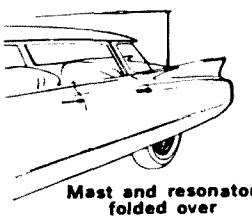
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However, the junk in the attic accumulated over the years until the receiver was only part of a dingy, dusty chaos perpetually over her head. Em, whose pride was the gleam and gloss of her arrid home, attempted to "clean up" the mess but she met with alarming resistance from Joe. Considerate as ever, he would say,

"Don't you go bothering yourself with the attic, dear. The stairs are too much for you. I'll look after it."

Sometimes, though, when he was away at work, she would trudge up the narrow stairs into the enemy territory and confront the bland, blank face of the detested receiver. She would even run her duster over its surface, for, hate it as she might, it was against her nature to tolerate dust. A more passionate woman might have smashed it beyond repair, so that it could no longer come between her and her husband, but care with money had become part of Em's life and she knew that, even second-hand, the instrument could realize good cash some time.

There were days, three or four sometimes, when Joe was all hers. He would sit opposite her by the stove. Neither of them was particularly articulate, but there was some kind of commune between them. She would knit. Joe read the paper, yawned, scratched himself and went early up to bed. Days after, she would discover, to her humiliation, that "the bands had gone dead," that radio communications the world over had briefly come to a stop, for reasons which were beyond her understanding and which she did not think it worth her while to try to understand.

Once a week, on Thursday nights, her resentment against Joe's hobby rose to hatred level. He would kiss her dutifully, tell her not to wait up for him and drive off into town in the current ten-year-old car to a meeting of the Amateur Radio Club. And every Thursday night Em would sit brooding over her knitting for she knew that, once Joe was with his cronies at the Club, he was no longer hers, no longer her man, her child, her property. He was beyond her control.

She always did wait up for him, greeting him sourly on his return, yawning ostentatiously. But inevitably Joe was so exhilirated by the meeting with his friends that he never even noticed her meaningful glances at the clock.

Sometimes Joe would suggest that she come with him to a social evening organized by the Radio Club for the wives of the radio amateurs. Most of the other women good-humouredly played along with their husbands in this respect, really enjoying the friendly atmosphere of the parties. They accepted their husbands' hobby for, to most of them, it was part of their lives, just as much as wage-earning or love-making. Their men's regular disappearance into the ether was no worse than the drift of other women's husbands into bar or pool-room.

Em could never come to terms with this attitude. She scornfully dismissed the other women, either as fools or flibbertigibbets who didn't look after their men properly. A badly-ironed shirt, a sock darned with the wrong color wool on another man would ensure her scorn for his wife. She never forgave the merry woman who blithely suggested that she forsake her weekly baking session to accompany her husband on National Field Day.

"Reckon she buys all her cakes in the store," she muttered. The condemnation was final, irrevocable.

Joe's friends rarely visited him at home but when they did she would be greeted respectfully; then the two of them would firmly climb the stairs to the attic and that was the last she would see of them for hours. Towards these men she maintained an icy silence, barely polite. They represented Joe's other world.

Then, a year ago, things had dramatically changed. An accident at work had broken Joe's spine. Weeks in hospital had ended with his being brought home to spend the rest of his life completely helpless, paralyzed from the neck down.

The doctor spoke to her pityingly, admiring the fortitude and lack of hysteria with which she bore the blow.

"He might live for months, or it might just be a matter of weeks. Do all you can to keep him comfortable and happy."

He might have spared his pity. Em's stoic expression concealed neither misery nor controlled shock. It hid a singing triumph. For

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hard physical work and extra financial scrimping held no fears for her. She could face them intrepidly for now she had her husband all to herself again.

Not since the very earliest days of their marriage had she been so close to him. She was his slave—but he was once more utterly hers, at her mercy, the child she had never had. She spent night after night without sleep, helping him through the pain and desperation. She performed uncomplainingly the most menial and offensive tasks. Out of their reduced income she managed to prepare luxurious dishes to tempt him, revelling in the slowness with which he chewed the food, whilst she held the next spoonful ready. On her he relied, not only for the very pith of his existence, but for companionship and entertainment. She read to him for hours. She rarely left the house and then only for necessities. She never spared herself, caring for his wasting body, putting into her scrubbing and bathing and mopping up of filth a devoted energy built up of years of frustration.

Financial difficulties meant sacrifices. Em was scrupulously fair. Her modest diamond engagement ring, her prized silver teapot and the radio equipment were all sold at the same time. Extra cash was needed immediately and it seemed logical that each of them should give up something valued and loved.

A winter passed. Em installed her small portable broadcast receiver in Joe's room. If she heard him the time he tentatively suggested that it might be possible to pick up part of the amateur bands on this instrument, she gave no sign. Joe had come back to her from his other world.

Soon, though, a crack appeared in the structure Em had built herself. One of Joe's radio friends called to see him. Em greeted him with the minimum of ceremony and unwillingly led him up to see her husband. She stalked out of the room, making it quite clear that their talk held no interest for her, but she knew with a shivering dread that something was going to happen.

The man left and she went back to Joe. His eyes were shining.

"They're going to build me a special receiver, Em—one that I can tune myself."

"What do you mean—tune yourself?" she said brutally, "You know you can't move a muscle!"

"One of the boys is an engineer. He's rigged up something with a lever that I can hold in my mouth."

Em's brief happiness dwindled to nothing instantly. She carried on with the tasks of running the house and caring for Joe, but she could feel the excitement building up in the man. Then came the call from the Club to say that the new equipment was complete and would it be convenient to bring it over. Em stalled for a day or so, making the excuse that she was spring-cleaning the room, that Joe

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FRONT & MAIN STS.
UPLAND, PENNA.

wasn't really well enough for all that excitement. Finally, though, realising fully well what she was doing for herself, she agreed to let them come over that Sunday.

On the Saturday night she had to give Joe one of the luminal tablets the doctor had left in her keeping, for he was so excited.

"Just think, Em," he babbled, "It'll be just like old times."

Her lips tightened but, when the Club members arrived, she was forced to have four of her husband's despised cronies trampling up and down the stairs, opening doors and windows, hammering and shouting and bringing a flush excitement to Joe's withered cheeks that all her devoted ministrations had never been able to arouse.

Dry-eyed she waited downstairs for the hubbub to quieten. Finally they came down.

"He's as happy as a kid, ma'am. Just you go on up and look at him."

"I'll wait until you've all gone. Then I can sweep through my front hall before I go wasting my time with that nonsense," she said ungraciously and did not relax until she heard the diminishing roar of their car engine as they drove away.

Stolidly and obstinately and carefully and very thoroughly she swept and tidied where they had trodden. When everything was once more in order she climbed the stairs heavily to Joe's room.

He lay there, still and quiet, with the ghost of a smile on his face. The engineer's tuning lever, no longer needed, lay on the pillow beside him.

Em wept the first bitter tears of a life-time when she came to realize that Joe had died happy and that his other world had won the last battle. ...G3NMR

Letter

Dear Wayne:

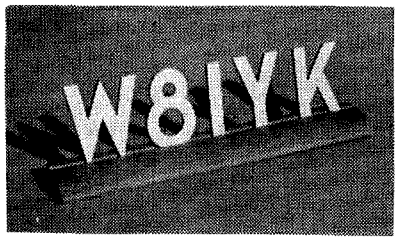
Anent my recent article about chirps in a kit vfo, I learned the reason for the poor performance of the dipped micas. They had cavities in the center where there was loose foil. Three out of five that I cracked open were faulty. I bought three of another manufacture locally and they all were solidly o.k. So, we can't condemn the dipped micas, per se, nor the manufacturer either, because a bad lot could get by easily. I have written the kit maker about it.

You may recall that I wrote an article for AP Features about working Russian hams. Someone from 73 mailed me a copy from the White Plains Reporter Dispatch. The article still is being run here and there, and I continue to get fan letters, with the most asked question being how to get into ham radio. I tell them to buy a copy of 73 and drool over the ads. But I made the mistake of recommending the Drake 2B receiver, and got a prompt reply from a lady who wants to know why I recommend the Drake, and it isn't even advertised in 73. Tsk, tsk. Oh well, I still think the Drake 2B is a good receiver, but please, get an ad from them.

The latest query was from a housewife in your area who wishes to buy her husband a ham station for Christmas. Lucky guy! Drake better get that ad in the next issue of 73!

Harold Carlson K7MSL

New Products

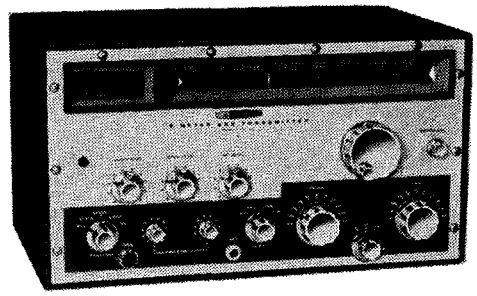


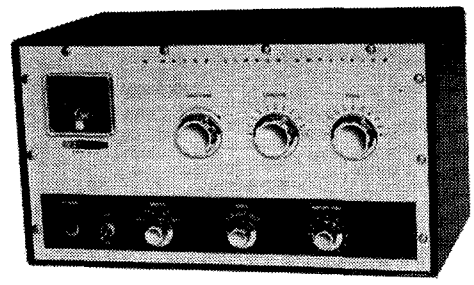
Only a Dollar

These little call letter signs are about the lowest cost signs we've ever seen. They are nicely made and great for mounting on top of relay racks, on the operating table, on the back shelf of your car, etc. Be proud of your call . . . display it. Made by New Products, Box 481, Grand Haven, Michigan.

Centralab Catalog

C's catalog 200, a 16 pager, lists everything Centralab makes in the line of controls, switches, ceramic capacitors and packaged circuits. It even gives prices. It certainly is well worth the three cent postcard required to have them mail it to you. Centralab, 900 East Keefe Avenue, Milwaukee 1, Wisconsin. Ahem . . . mention 73 . . . they're not advertising here yet.





Six Meter SSB

Six meters, though one of our most active bands, has been slow to shift to sideband. One reason is obviously the lack of six meter sideband equipment which is now being delacked by a number of manufacturers. Heath has just recently announced a six meter sideband exciter (10 watts) with built in VFO for $189.95 in the usual complete easy-to-build kit form and a companion linear which boosts that to 125 watts PEP for $99.95. The spex make these look like well designed units and they should do a lot toward popularizing SSB on six meters. Heath will send you full info on this pair if you ask. Heath, Benton Harbor, Michigan.

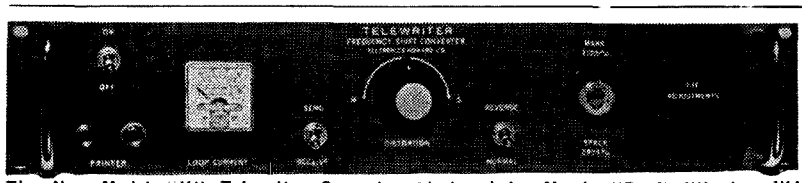


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82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. **$3.00**

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David Cabaniss W1TUW

HERE IS A SIMPLE little circuit that will open the eyes of all mobile men. It is simple, cheap and you can build it in about an hour's time. The few parts required can be squeezed inside most any radio. Here is how it works.

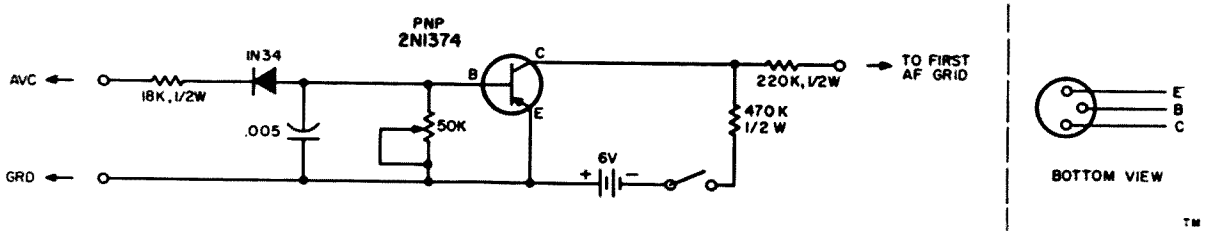
With no signal being received, the negative AVC voltage present at the base of the transistor is low. The transistor is therefore "Cut-Off," and there is no current flow through the 470K collector resistor. The voltage at the collector is now a negative six volts. This negative six volts is applied directly to the grid of the 1st Audio tube, through a 220K resistor, driving this tube to cut-off, thus silencing the receiver. When a signal is received, and the negative AVC voltage is applied to the base of the transistor, the transistor conducts, thus pulling current through the 470K collector resistor. The voltage at the collector drops almost to zero, thus removing the negative voltage from the grid of the 1st Audio stage, allowing the receiver to operate in a normal manner.

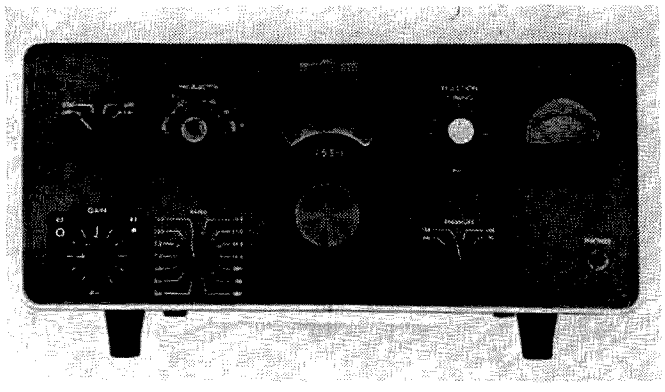
The setting of the 50K potentiometer determines the level of AVC voltage necessary to operate the squelch. The 1N34 diode prevents the negative voltage from the battery from being applied to the AVC line. (When wiring this circuit, be sure to note the polarity of the diode.)

The component values shown on the circuit diagram were optimum for the particular receiver in which the author's squelch was installed. When this circuit is installed in other receivers, it may be necessary to lower the value of the collector resistor (470K) or increase the value of the input resistor (18K) (or both) due to the various levels of AVC voltages available from different receivers. Almost any inexpensive PNP type transistor can be used.

The author has spent many agonizing hours "trying" to build various types of squelch (and ANL) circuits using conventional electron tubes; after building this gimmick, I'm convinced that transistors are "Here to Stay."

. . . W1TUW





The Waters Notch Filter

Tom McCann K2CM
146 Hillcrest Avenue.
Morristown, New Jersey

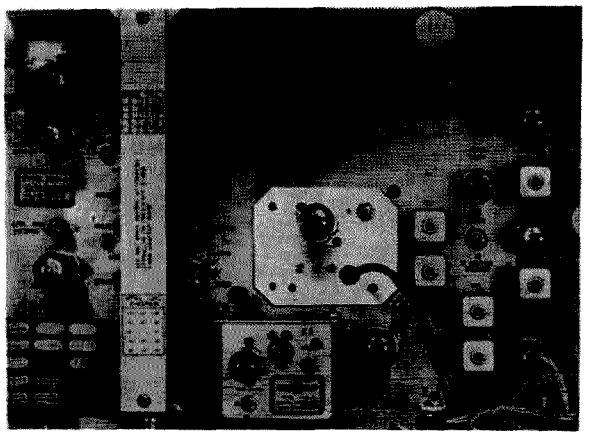
TIMELY RELIEF is at long last afforded owners of KWM-2 transceivers and 75S-1 receivers who have frustrated when a big, hot heterodyne parked in their passband and swamped out the wanted signal. Waters Manufacturing has an *inboard* notch filter for these luxurious rigs at less than three percent of the bucks you put into the transceiver and an hour or less of installation time.

Coded 337-S-1 and 337-M-2, either model at $33.95 net, these new units are furnished assembled, complete with the knobs and escutchion plates matching the Collins panel. When the unit is mounted, it looks, performs and handles like Mr. Collins himself furnished it with the equipment in the first place.

No drilling is necessary to mount these units or the controls, except for one hole in the

KWM-2 panel which is thin aluminum at the point selected and is an easy operation with the template provided. Installation and connecting instructions are furnished in the form of clearly stated numbered items of procedure. For those who are nervous about "lifting up the hood" of these pretty boxes, we understand the Collins service stations will gladly do the installation job for a nominal charge.

Q-multipliers and their equivalent have been available to us now for several years. They can be tempermental things. My own experience with them covers varieties all the way from home-spun, through kits to various commercially available units. Some have been unstable, some have a good depth of notch but take out too much of the wanted signal, others have required a critical adjustment of balance to attain satisfactory suppression without impairment of the wanted signal. So my curiosity was more than a little aroused as to how Waters achieved a remarkably narrow notch



which is effectively deep (40 db) and is at once so stable and easy to adjust to the interfering signal.

Its quite apparent that Waters engineers have shrewdly taken full advantage of the specialized characteristics of the Collins equipment for which their unit is specifically intended. They use a bridge T network with a carefully designed high Q shunt-tuned coil as the series element. This network is in the plate circuit of a 12AX7 tube which serves as a cathode follower coupled to a regenerative amplifier. This combination is connected in series with the *if* amplifier of the set at the low level end. The regenerative amplifier is adjusted below the point of oscillation where the plate circuit has a very high Q and introduces a high loss to a very narrow band of frequencies. The front panel tuning control moves the notch from well outside one edge of the passband, through the passband to well out the other side. Dealing with the uniformly excellent shape factor of the mechanical filter and a fixed passband of 2.1 kc, Waters adopted a tuning range of 455 $\mp$ 2.5 kc, so when not required, the rejection notch is simply dropped over the steep slope of the mechanical filter by tuning it to either extreme. The insertion loss with the tuning control in either extreme position is less than a quarter db.

The Waters 337 unit provides amazingly satisfying relief both from heterodynes appearing in the receiver passband and from "monkey chatter" slopping into the passband from signals just above or just below the selected channel. Sophisticated operators seldom operate their receivers at maximum rf gain unless they are "digging for the weak ones." They run their gain at the point where the incoming signal at its lowest fading level just ticks the S-meter. Operated in this manner, the Q-notch will supress practically any heterodyne except from the KW next door. While the Q-notch is inherently a very narrow band device, smart operators are finding them remark-

73 Products

TV BULLETIN
$1.00 per year

The first issue of the TV Bulletin is now ready for mailing. This is a bi-monthly bulletin designed to keep all fellows interested in Ham-TV up to date on technical improvements in Ham-TV gear and on all activities. In the first issue of the Bulletin there is a list of all known hams who are reported to be getting on the air on TV. The Bulletin is edited by Mel Shadbolt, WøKYQ, the author of the popular HAM-TV book. Get in on this from the first issue and have a complete set of information at your fingertips. The present plans call for six issues of the Bulletin per year, with at least 12 pages per issue.

BOUND VOLUME $15

If you've missed the early issues of 73 this is a fine way to rectify that oversight. This book will keep you up to all hours of the night for weeks trying to catch up with the hundreds of articles we have published and the ridiculous editorials. This volume contains the first 15 issues of 73, from #1 in October 1960 to December 1961. Bright RED, stamped in gold.

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73 Peterborough, N. H.

ably effective in suppressing "monkey chatter" by setting the notch just inside the high or low edge of the passband. This has the effect of narrowing the receiver passband, which under conditions frequently encountered, can make the difference between "getting the message through" or having to give the whole thing up in disgust.

A Q-notch Model 340-PT ($44.95 net) has recently been made available for transceivers associated with a separate PTO for separate receive and transmit frequency control of the KWM-2. No Q-notch is presently available for the KWM-2A equipment equipped with extra crystals for Mars and other frequencies as Collins has used the rejection tuning control mounting hole in these models.

You'll like this Waters Q-notch. It performs beautifully and looks good. It certainly will enhance the value of your current equipment.

. . . K2CM

WOW!
WHAT A MERRY XMAS!

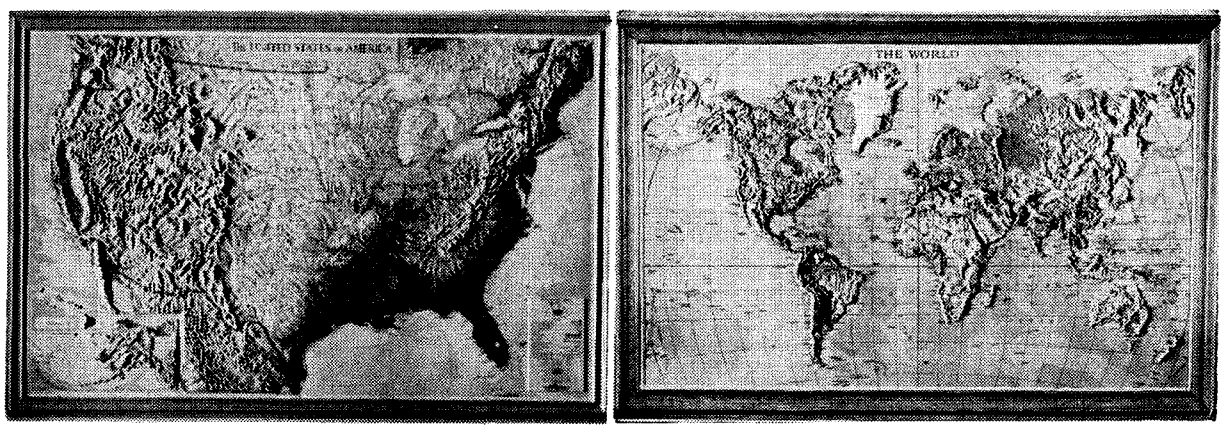
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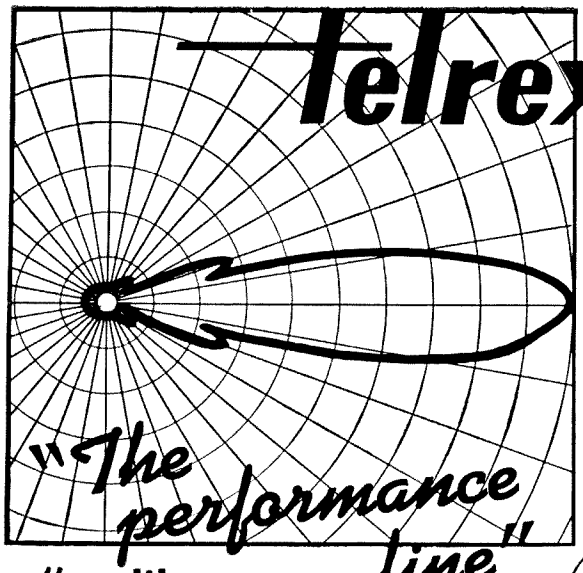


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would give you one of these if he could make 'em, but it takes huge machines to crank these precision moulded gems out. Give one to the XYL for Xmas, be a Dandy Sandy. Give one to the Jr op so he can put it up on your shack wall. But when you give it you don't have to let on about the free one year subscription to 73 (or extension) that we're sending. Now, about these maps . . . they're 28½" x 18½" and the mountains stick right up at you, all in the right places. This is not one of those cheap crumby maps either, it is an expensive uncrumby one with eight colors, all different. Send.

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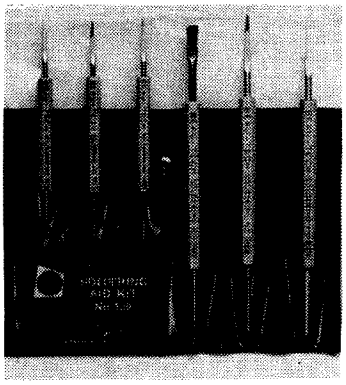
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New Products



Soldering Tools

Time was when a soldering iron was considered the tool necessary for soldering. Beau-Tech Tools has a complete kit of tools out (for $4.87) for soldering, none of which is an iron. Little gadgets like scrapers, reamers, forks and brushes. Gad! Made of varnished maple and spring steel (much better than fall or winter steel). See your dealer.

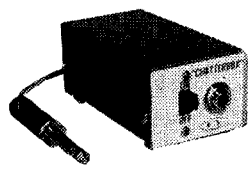
Supreme Towers, Etc.

Are you still struggling with dipoles and verticals? There is nothing like swinging a beam from forty feet or so since antenna height is one of the most important factors in getting out a potent signal. Supreme has a fine catalog out on their line of 40 and 60 foot crank-up towers which start at $119! Write Supreme Electronics, Front & Main, Upland, Pennsylvania. You might also ask for a little info on their new six meter SSB transmitter if you're VHF'ly inclined.

THE CHATTERBOX!!!

ALL TRANSISTORIZED SPEECH CLIPPER-FILTER

Maintain Full Modulation—Multiply Audio "Punch"



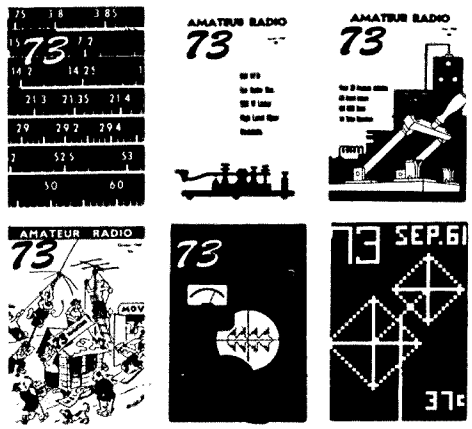
- Rugged P.C. Board
- Not a Kit—Ready To Use
- No Modification To Xmitter.
- Self Powered— Batteries Incl.
- Shaped Audio Response
- High Q Toroid Filter
- True Clipper, Not Compressor

Phone Plug and Jack Standard—Other Types Available

C-Y ELECTRONICS
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$24.95 Postpaid
Ohio Res. Add 3%
Send For Free Flyer

BACK ISSUES



We have a diminishing stock of all back issues except January 1961. We are willing to part with this stock for only 50¢ each. How about that!

73 Peterborough, N. H.

(W2NSD from page 4)

W6RNC is still turning out junk mail from his hot little mimeograph and the pity of it is that every now and then he finds a sucker to reprint some of his garbage in a ham club bulletin.

Look fellows, if the editor of your club paper lives in such a vacuum that he doesn't know what the ACARN is really all about then please give him the word. This supposedly extreme rightist group (one man) is using the time tested communist technique of waving the flag and calling everyone who objects to him a communist or a pinko. I don't know if this joker is a communist, but he certainly is following their line.

The basic "idea" espoused by W6RNC is that we should use ham radio to broadcast U. S. nationalism, including twice daily playing of the NATIONAL ANTHEM by every American station. This is supposed to counter the expansion of communism. What fantastic stupidity! The FCC and every responsible thinking amateur is on this guys neck. He will shut up when everyone ignores him. Explain to your club paper editors.

One of the latest blasts was at the International Ham Hop Club, which RNC called pinko. Balderdash. First of all the IHHC has virtually no organization other than a couple of fellows who coordinate the desires of fellows to put up visiting hams with the desires of traveling hams to visit hams in other countries. The only political piece that they have ever put out in their little bulletin was one which I suspect makes RNC furious. . . . It was a list of the popular complaints about the United States which you might face during a trip through Europe and good logical explanations to answer these questions. The paper was very well done and gave well thought out answers to all sorts of anti-U. S. gripes. This is the sort of thing which obviously would enrage dedicated communists. I considered printing the piece in 73, but decided not to on the basis that few of our readers would be able to use it. I have met many of the questions it answered during my trips to Europe, but haven't run into them over the air.

Watch for my name on the top of the pinko or red list from RNC (ACARN) next month . . . hi! That's the only way he can fight facts.

Reciprocation

Well, Congress adjourned without considering our Reciprocation Bill, thus limboing it with all other unenacted proposed legislation. What happened? Apparently somewhere along the line some government agency brought up the dread word "security" and that was that. This means that important foreign amateurs visiting this country can not, even if the FCC considers it a matter of great importance, allow them to operate an amateur station in this country.

When you consider the number of Americans that have been permitted to operate in foreign countries you can perhaps understand why this is so galling to foreign amateurs. Unfortunately for us the same amateurs who are effected by this ruling also are the ones who swing considerable weight in their own countries. Outside of an occasional grumble when you work or visit a DX operator you probably won't notice much difference in things until the cards are on the table at the next international radio conference at Geneva in about three years. At that time we will be wanting the entire world to support the largely American hobby of ham radio by sacrificing the frequencies that they feel they badly need for commercial and government purposes so we can continue to have a good time. We almost got our ears pinned back in 1959. Our "friends" were after our scalp and guess who pulled our chestnuts out of the fire . . . the U.S.S.R.! Is it likely to happen again? No.

Why no reciprocation legislation? Apathy.

It is unfortunate that we have fellows that are quite dedicated to undermining our hobby and no one, apparently, dedicated to its survival.

RM-341

A petition was sent in to the FCC requesting the expansion of the twenty meter phone band down to 14,150 kc. After only a short deliberation this petition was rejected. We have much to learn from this action. In this case there were many factors which made consideration of the actual request almost impossible. The petition itself was wandering and vague. It went on and on with non-pertinent rambling, complete with a bitter attack on the A.R.R.L. Publication of the petition as submitted would have put the FCC in the position of publishing a long harangue against the A.R.R.L. Now, no matter what the feelings of the men at the FCC, they certainly can't do that.

The petitioner proceeded to put undue pressure on the FCC for action on his petition, rather than waiting for them to take action on their own. He circulated his petition and got it printed in several ham club bulletins whose editors didn't mind the anti-ARRL nature of the text. He pressured on the air, wrote letters,

etc. If only we had had someone as dedicated working for the reciprocal licensing bill!

The ARRL, according to the November issue, page 61, is looking into expulsion of the petitioner from the ARRL.

The FCC had several other problems with this same chap, and these might have influenced them negatively. There were numerous reports of TVI in which he was uncooperative, complaints of overpower, complaints of excessively broad and splattering signal, complaints of malicious interference, and several other serious problems much too lengthy to cover here. Quite a few people seemed to suspect that the petition was submitted more for personal reasons than any interest in the hobby.

If there are adequate reasons for the twenty meter phone band being extended down 50 kc more, then I am sure that the FCC would welcome a reasonable petition requesting same.

How Long Has This Been Going On?

A letter came the other day, sent to my Call Book address in New York, extolling the virtues of Rockefeller, complete with illustrated brochure, sent by four New York hams, including one lesser A.R.R.L. official. Since these fellows were, as I recall, the same chaps who conferred with one of Rockefeller's aides in the matter of getting the New York call letter license plates, it seems rather obvious that some sort of bargain was struck. That's the way politics works, I suppose. Are the New York lads in there with a new first, using ham radio for political ends, or have I just been out of touch?

Several religions have been using the ham bands for "discussions" with the idea of gathering more adherents. The anti-communists are going great guns with their nets (they say they are anti-communists, but everything they print sounds exactly as if it came directly over Radio Moscow), perhaps we will soon see Democratic nets, Republican nets, and Vegetarian nets. I'll be watching the Operating News column in QST for further developments. Anybody for a Porsche Net? Or how about a Ham Radio Net for the few of us who are interested in that?

National NCX-3

Our proximity to Boston and the National Company plus the understandable pride in a startling new product brought Mike Ferber, W1GKX, the Equipment Sales Manager, up here on a Sunday to show off the new National Tri-Band NCX-3 Transceiver.

We looked it over, talked it over and then hooked it up and tried it out. I like trans-





SPECIAL! 144 or 220 mc TRANSMITTER

20 watts! Simple to convert 242 mc DXT-2 Beacon Transmitter, measures 4" x 4" x 11" complete with antenna, water-tight case and sidetone modulator. Power required 300V DC & 6.3V. Uses two 12AT7 and one 6360 final (not furnished). Schematic and 2-meter conversion data included. Hundreds sold already at this fabulous price. BRAND NEW, only **6.95**

(See SB conversion Oct. '62 CQ)

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ceivers. We had the thing on the air and in a QSO inside of one minute. All we did was connect the power supply/speaker unit to the transceiver, plug it in the wall, screw on the antenna, plug in the mike and we were on the air.

There wasn't any point in trying to set up a big lab test at this time since we were interested in getting reports from some critical operators and getting the feel of the transceiver. The reports on both 20 and 75 were completely complimentary . . . we were putting out a clean, strong signal and voice quality was fine. We tuned 40, but didn't try to make a contact there. The receiver tuned nicely, having plenty of bandspread and a solid feel to the nice large knob. At $369 for a three band transceiver I suspect that National will sell an awful lot of these.

Judging from the large number of transceivers that will be on the market by next spring, the manufacturers are intent on satisfying the pent up demand for sideband transceivers for mobile and home use. The day may not be far away when most of us are using transceivers instead of the old receiver-transmitter combinations.

What About CD?

Though the odds are overwhelmingly against any possibility of war, the recent Cuban affair got a lot of fellows thinking about CD and the part that ham radio would play should something happen. It is always better to consider alternatives before an emergency rather than wait until the emergency presents itself and sound consideration is impossible with temporary expediency becoming the rule.

At the outbreak of the last war we were promptly thrown off the air. This freed equipment and frequencies for military use. (My old SX-24 went to Brasil with the Rubber Development Commission, a government outfit that spent millions of dollars to try to grow rubber in Brasil and never sent back a rubber band. The 2½ meter band was turned over to the SD radar, a unit that was planned as an anti-aircraft radar, but which turned out to be a wonderful homing beacon for aircraft looking for submarines).

It seems likely that in the event of another war our government, if they have time for such an action, would again institute a complete ham radio blackout. Of course, if the next war takes the course that we think probable, we may find our telephone, telegraph and power systems all disintegrated . . . which would essentially leave us governmentless. Without communications you don't have any government. Our country could conceivably be held together by amateur radio. What else have we got?

Pursuing this thought a bit, it seems to me that there should be some encouragement above and beyond Field Day for the establishment of independent power for our stations. It might also be a good idea to acquaint amateurs with cyphering techniques. There are several fairly simple but effective systems which we could experiment with were it not for the FCC regulations prohibiting this. Perhaps it is time for someone to petition the FCC to permit encyphered transmissions on, say, two meters, where our Technicians could get a chance to play around.

Club Notes

A letter from K7RPT of North Bend, Oregon, suggests that we follow up the article on page 50 of the October issue of 73 wherein it is suggested that clubs have a local net by the establishment of a sort of national net frequency. I have been sort of tinkering with this idea myself. RPT suggests that we standardize on 29.2 mc since this is fourth harmonic of the popular surplus 7300 kc crystals. I've checked with a couple of crystal manufacturers and find that we can get a good supply of crystals all on the same channel quite reasonably. With a little encouragement we might see what we could do about this.

It seemed to me that it might be nice to establish channels on all amateur bands for members of the Institute of Amateur Radio to congregate . . . sort of calling frequencies. The number 73 somehow seems to wander through the suggested frequencies. Like 145.73 mc, 50.73 mc, 21.373 mc, 14.273 mc, 7173, 3973, etc. And thoughts on this?

ARC-2

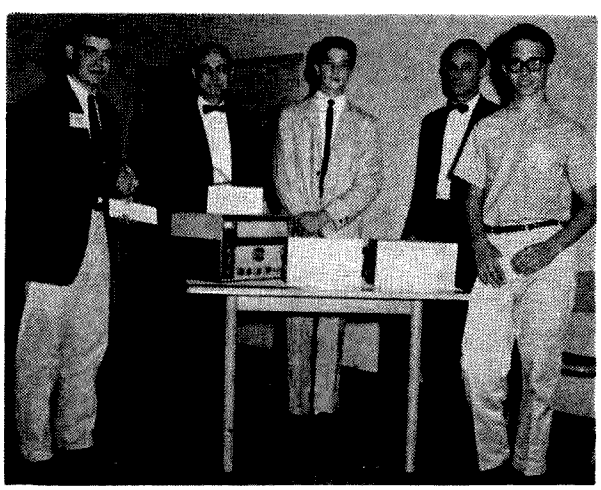
Several fellows have written in to tell us how much fun they are getting from their ARC-2's which they converted per our article in the October 1962 issue. They seem to be available from Columbia, JJ Glass, Fair and Bill Slep. The parts list for Fig. 3 was not complete and the following might be helpful. T1-117vac/24v 4A Stancor P-6378 or equal. CR-1-CR4 silicon diode 400v PIV 500 made Sarkes-Tarzian M-500 or equal. CR-5-CR-8 silicon diode 50v PIV, 3A dc if autotune *not* desired or 6A dc if desired, available from TAB for 50¢ 3A or $1.50 for the 6A. J401 is ex-dynamotor connector and P101 is main power connector. We are working on a booklet on the ARC-2 which should be available in a few weeks. It will sell for $1.

Saddle Stitching

Some of the letters ask when we are going to change from a saddle stitch binding to the flat back binding used by CQ and QST. Well, I really hadn't planned on changing. We could save quite a bit each month if we went to this less expensive binding, but it seemed to me that saddle stitching was better since it allows you to lay the magazine flat for reading and for building from the articles. Did you ever try to flatten out a copy of QST and lay it on the workbench? There are several of the larger magazines that use saddle stitching, including the New Yorker and Playboy. Unless you have some reason for wanting us to change we'll stick with saddle stitching.

WϕRQF Improvement

The schematic on page 90 of the March '62 issue of 73 was pretty good, but not perfect. RQF points out that the one meg resistor in the plate of V2 should be moved to the right one connection so the NE-51 won't have plus 300v on it. If you are going to do any RTTY converter building you had better go back and mark that diagram right now.



Prize Winners

The Rock Creek Amateur Radio Association (Washington, D. C.), W3RE President, has taken a long step forward in this day and age of kit building and 100% commercial gear stations. They have instituted a yearly set of awards for the best home built equipment by beginners licensed less than one year. The winners this year were Donald Campbell KN3RAZ, Larry Rubin KN3STB and James Henkel KN3TIV, all of Maryland. Left to right in the photograph are KN3RAZ, Robbie W3RE, KN3TIV, Joe W3PIH (contest chairman) and KN3STB.

Say You Want A Deal?

ON A NEW

HX-50, HQ-110A, HQ-170A, HQ-180XE
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TA-33 HAM-M ... ETC.

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TTY GOODIES

BOEHME TTY RECEIVING UNIT, AM103BU new in crates w/spares and manuals	$22.50
MANUAL ONLY FOR AM103BU (above)	1.00
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TUBE KIT, Manuals & Spares for above	7.50
MANUAL ONLY FOR CW50124 (above)	1.00
POLAR RELAYS, TYPE-D164816, new in Ctn. Similar to but smaller and more flexible than the 255A. Has 3 windings. Can be used in plate circuit (write for free diagram)	1.95
AMPHENOL 9-pin socket for above relay	.25
REPLACEMENT ARMATURE Coil for above	.50

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J-37 KEYS, USED—AS THEY COME	1.00
NAVY KEY, NEW, CJB26003A (worth 5 times our price)—THE REAL McCOY	2.95
DOW KEYMUNICATOR, new, while they last	4.95
TG5B TELEGRAPH SET, new, complete with headphone, key and carrying case in overseas pack	9.95

New AN Meters & Ind.

0-8 VAC 3½" R	$3.95	I-82A, Ind., new	$3.95
0-10 VAC 2½" R	3.95	I-81A, Ind., new	2.95
0-150 VAC 3½" R	3.95	50°C Thermostat	2.95
0-250 VAC 4½" R	4.95	0-1 MADC 2½" R	3.95
200-0-200 VDC	3.95	0-15 MA 2½" R	3.95
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0-50 MMA 2½" R	6.95	0-30 MA 2½" R	3.95
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R–45/ARR–7

Receiver Modifications

James M. Stueber W5UOZ-AF5UOZ
8410 Flower Place N.E.
Albuquerque, N. M.

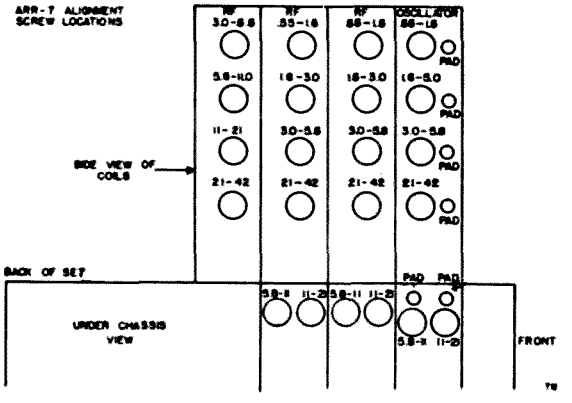
THE R-45/ARR-7 receiver is a continuous tuning type covering the range of .55 mc thru 42 mc. It is a single conversion superhetrodyne circuit, with two tuned rf stages and one untuned preselector rf stage. The design is a modification of the well known Hallicrafters SX-28 receiver. The particular modified receiver was built under a Signal Corps contract by the Belmont Radio Corp.

Inclusion of the described changes will provide the user with a good communications receiver, overcoming the major disadvantage in the original design, which is the lack of bandspread tuning.

A schematic of the receiver and a coil layout for alignment purposes is included for those who may require them.

Appreciation is extended to Mr. Amos Peters, AF5LHX, for supplying the receiver through the MARS Central Technical Net, thereby making these modifications possible.

The changes described consist of the following:



1. Addition of bandspread tuning and dial
2. Addition of necessary wiring to provide ac power supply operation
3. Addition of Send-Rcv. Switch
4. Improvement of "S" meter circuit
5. Audio amplifier modification for speaker connection
6. Low impedance antenna input stage

Bandspread Tuning and Modification for ac Power

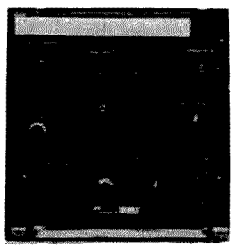
1. Remove the screws holding the cover plate which houses the tuning dial motor reversing switch and stop mechanism. Discard.
2. Cut the wires from the motor reversing switch SW3 and remove the switch.
3. Remove the stop mechanism from the main tuning dial shaft and discard.
4. Remove all the knobs from the receiver and the screws from the power connector so the front panel may be taken off.
5. Remove the main tuning dial by loosening the allen-head screws.
6. Remove the cover from the cast aluminum housing containing the 28V dc motor and associated parts.
7. Remove the filter, motor and misc. parts from inside the box.
8. Remove the fiber gear from the vertical shaft.

This may be sealed with paint and may be difficult to loosen, but with the proper size allen wrench and solvent to loosen the paint, it will come loose.

Meshna's Astoundments

TELETYPE PRINTER PAPER, rolls, 8½ inch wide	2/$1.00
TELETYPE PERFORATING PAPER, case 40 rolls	5.00
ARC-5 TRANSMITTER, 80 meters, 3-4 mc..	8.50
MD-7 MODULATOR, brand new	8.50
IBM MEMORY PLANE, 8,000 bit storage....	15.00
COAX SWITCH, Thompson, new, 115 volt AC 60 cycle	12.50
SOLAR CELL BANK KIT, 5 cells, with instructions	1.50
OSCILLATOR TRANSISTORS, same as PHILCO SB-100	2/3.00
RESISTOR ASSORTMENT, marked ½ watt, carbon 100	1.00
28 VOLT 4 AMP DC SUPPLY, unused surplus, input 115 v. 60 cycle	12.50

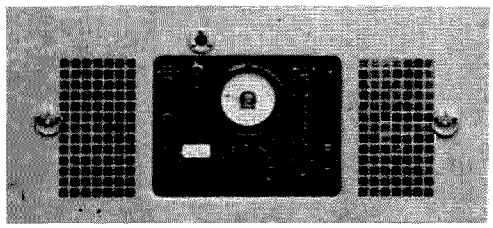
MICROAMETER, dual 150 microamp movement, used in teletype operation as signal meter w/instruc.	$1.95
COLLINS ARC-12 TRANSCEIVER 220-400 mc	22.50
1,000,000 KC CRYSTAL, HC-6 holder.....	2.00
220 MC DIPOLE ANT. BRAND NEW.....	3.00
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DISC CERAMIC COND. bag of approx. 100	1.00



L M FREQUENCY METER

with book, OK, **$49.00**

TD-2



TD-2 MICROWAVE GENERATOR with WE 416B, 2C43, etc. Complete as shown, output of 3700-4200 mc. Elaborate transmitter used by WE for microwave transmission. Frequency multiplier stages may be tapped for lower output frequencies, makes nice stable pump source for parametric amp., lab signal source, etc. $40.00
With extra amplifier stage and tube 50.00

NEW CATALOG #62-W1 just out. Send one thin dime for handling charge.

All material FOB Lynn, Mass.

JOHN MESHNA JR., 19 ALLERTON ST., LYNN, MASS. (617) LYnn 5-2275

9. Remove the potentiometer R41 and bracket, located on the top rear of the chassis. Cut the wire leads free near the potentiometer terminals and leave them in position.
10. Remove the wires from the POWER switch, tie together, solder and insulate.
11. Remove the white wire with blue and orange tracer from the MOTOR switch.
12. Remove the ground connections from pins A and C of receptacle SO-1.
13. Attach the white wire, with blue and orange tracer, which was removed from the MOTOR switch, to one lug of the POWER switch.
14. Attach the other end of the wire which was attached to the motor, to pin C of SO-1 connector.
15. Cut the white wire with green tracer from the MOTOR switch and attach to the other lug of the POWER switch. Pins C and D of SO-1 now become the ac switch-wires to turn ac power off and on.

The bandspread tuning knob will project out of the top of the case, since there is no front panel space available.

16. A three-eighths inch hole is drilled in the top of the cast aluminum motor housing located 11/16 inch from the front of the case, and ¼ inch from the left. A shaft bushing is installed in this hole to accommodate a length of ¼ inch diameter shaft and solid shaft coupling. The bandspread tuning will be engaged by throwing the MOTOR switch to ON, which engages the electric clutch in the tuning mechanism. When fast tuning is desired, the MOTOR switch is thrown to OFF and tuning is accomplished with the TUNING knob.

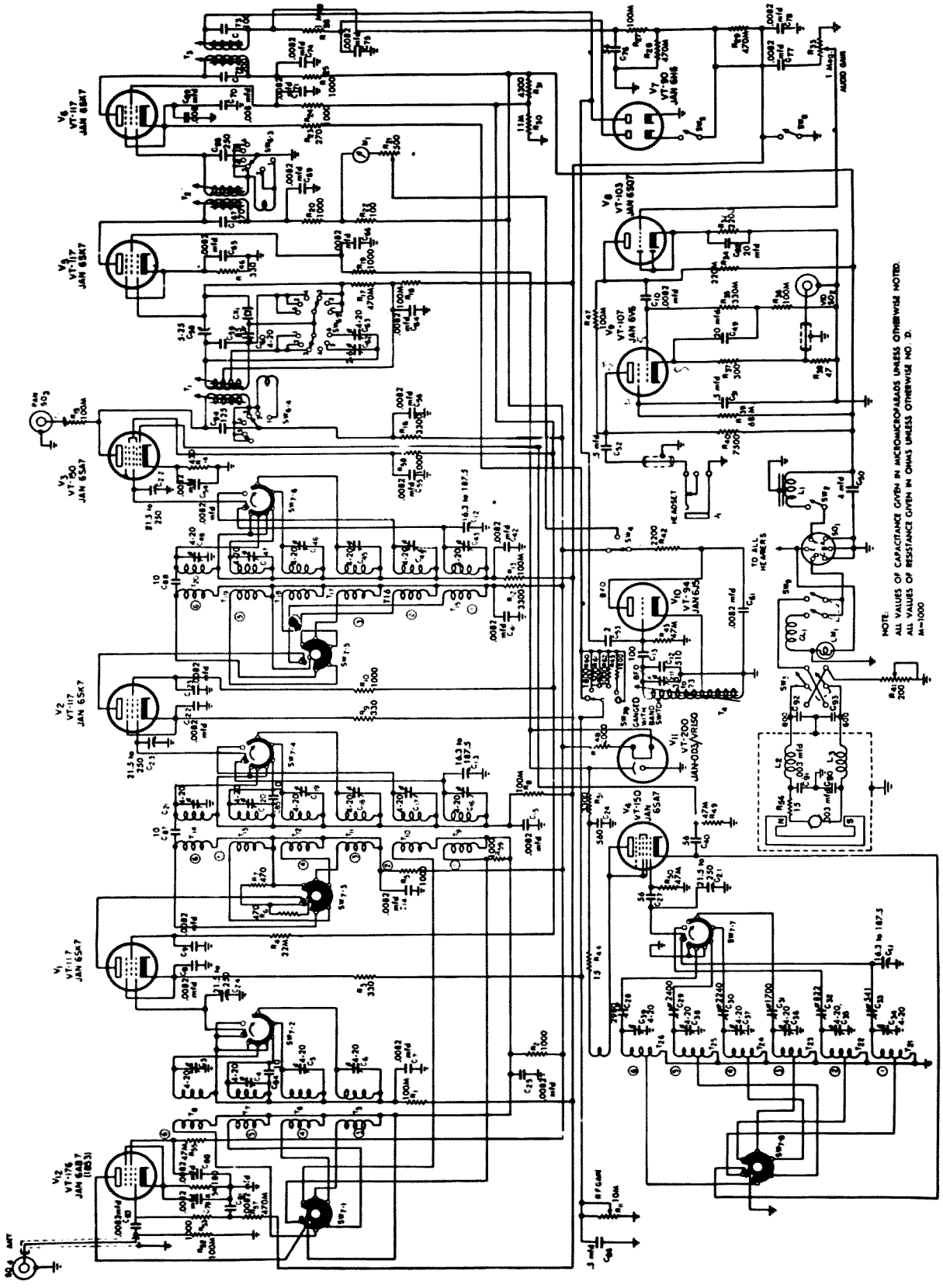
Parts are now installed to provide dc voltage to energize the clutch.

17. Mount a 6.3 volt 1.2 amp. filament transformer under the chassis on the side lip near the SO-1 connector. Refer to Fig. 1

K T V

We spent our years advertising budget in October, so look back on pages 40 and 41 of the October 1962 issue of 73 and see what we have. You'll find complete prices and ordering information there.

KTV TOWERS, SULLIVAN, ILLINOIS


NOTE:
ALL VALUES OF CAPACITANCE GIVEN IN MICROMICROFARADS UNLESS OTHERWISE NOTED.
ALL VALUES OF RESISTANCE GIVEN IN OHMS UNLESS OTHERWISE NOTED. K=1000
TO ALL HEATERS
HEADSET
BFO
CALIBRATED BAND SWITCH
AUDIO GAIN
ANT

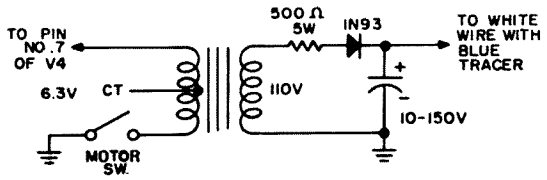


FIG. 1

for the schematic of this portion of the modification.

18. Connect one of the 6.3 volt leads of the transformer to pin 7 of 6SA7 tube V4.
19. The center tap connection of this winding is not used, so cut the lead off close to the transformer winding.
20. Remove the wire with blue tracer from the MOTOR switch.
21. Connect the other 6.3 volt lead to one contact on the MOTOR switch.
22. Connect the other switch contact to a convenient ground.
23. The 500 ohm 5 watt resistor, the 1N93 diode, and 10 mfd capacitor are conveniently located near the transformer on a three lug terminal strip and wired as shown in Fig. 1.
24. Connect the wire with blue tracer, which was removed from the MOTOR switch, to the junction of the 1N93 diode and the 10 mfd capacitor shown in Fig. 1.

Addition of SEND-RCV Switch

1. Drill two holes in the front panel which will accommodate a SEND-RCV switch and a pin jack (RCA Phono Jack) for a keying relay connection. Due to the close spacings and limited panel space available, care must be exercised in location of the two holes. A ½ inch hole for the SEND-RCV switch is located 5½ inches from the left and 1 13/16 up from the bottom. A three-eighths inch hole for the pin jack is drilled 6 inches from the left and 2 7/16 inches up from the bottom of the front panel. Refer to Fig. 2 for the schematic of the circuit.
2. Estimate the length of wire needed to go from pin A and B of SO-1 to the new SEND-RCV switch, a SPST toggle switch on the front panel, and install these leads. Do not solder these leads at the toggle switch at this time but solder at pin A

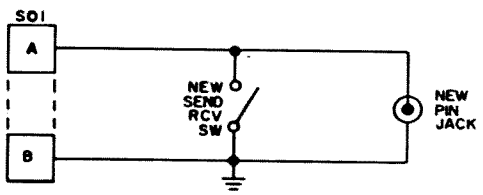


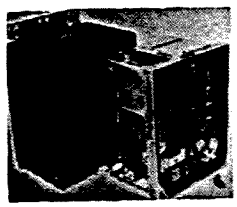
FIG. 2

ARC-3 and ART-13A TECH MANUALS!
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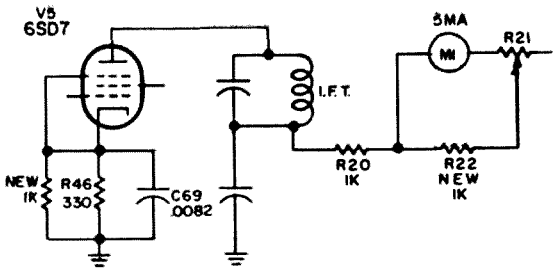


FIG. 3

and B of SO-1.

3. Estimate two lengths of wire to run from the toggle switch to the pin jack. The toggle switch wire from pin A of SO-1 goes to the insulated lug of the pin jack and the other wire from the toggle switch to the ground lug of the pin jack. Solder all these leads at this time.
4. The main tuning dial, front panel, and knobs may now be reassembled.

Improvement of "S" Meter Circuit

It was found that the maximum deflection that could be had from the local broadcast signals was S-6 with the original circuitry. The following changes will improve the circuit. Refer to Fig. 3 for the revised circuit.

1. Replace the 6SK7 tube V5 with a 6SD7 tube.
2. Change the 100 ohm resistor R22 to 1000 ohms.
3. Add a 1000 ohm resistor in parallel with the 330 ohm resistor at he cathode of V5.

Audio Amplifier Modification

Refer to Fig. 4 for the revised circuit.

1. Remove the 68k resistor R39 located on the terminal board on the back chassis lip.
2. Tie a jumper wire across the two terminals where R39 resistor was removed and solder.
3. Remove the 7500 ohm 10 watt resistor R40 located in a cluster of four upright resistors under the chassis near the rear.
4. Connect the two white wires with red tracers together after removing them from R40, insulate and solder them.
5. Install a 5000 ohm to 8 ohm output transformer in the location on top of the chassis near the rear where the R41 potentiometer and bracket were removed.
6. Remove the white wire with blue tracer attached to pin 3 of 6V6 tube V9. This wire leads to a .5 mfd capacitor C52 which is a metal can type and is the bottom unit of two stacked ones near the cluster of upright mounted 10 watt resistors. This capacitor may be removed or left in, as desired, and white wire with blue tracer may be removed from the harness or clipped short and left in.
7. Install a wire from the other terminal of C52 to a lead of the 8 ohm secondary of the output transformer. (There is already a shielded wire attached to this terminal of C52, leave it there.)
8. Tie the other lead of the 8 ohm transformer secondary to any convenient ground. The white wire with black tracer which attached to the potentiometer R41 may be used for this ground.
9. Connect one wire of the output transformer primary to pin 3 of 6V6 tube V9. Do not solder.
10. Connect the other primary wire to pin 4 of 6V6 tube V9. Do not solder.
11. Remove the 100k resistor R47 connected from pin 3 of 6V6 tube V9 to a terminal

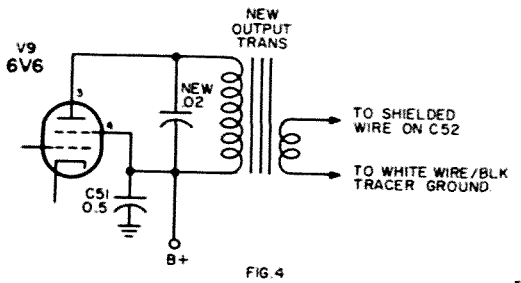


FIG. 4

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10 to 17 mc. Fund	4.50	4.00	3.35
2 to 2.9 mc. Fund		4.00	3.35
50 to 60 mc. F.M.	5.50	5.00	4.00
50 to 80 mc. F.M.	6.00	5.50	5.00
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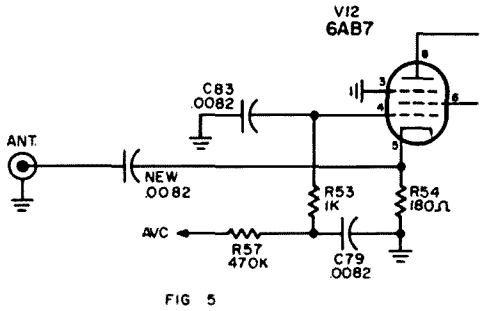


FIG 5

board on the rear chassis apron. Removal of this negative feedback resistor will result in greater output and better communications quality.

12. Install a .02 mfd 600 volt capacitor from pin 3 to pin 4 of 6V6 tube V9 to reduce high frequency response. Solder the connections.

Either headphones or a speaker may be connected to the PHONES jack.

Low Impedance Antenna Input Stage

Refer to Fig. 5 for the revised schematic.

1. Remove the wire lead from pin 5 to pin 3 of 6AB7 tube V12.
2. Connect a wire from pin 3 to pin 1 of this tube socket and solder.
3. Remove the .0082 mfd capacitor C79 from the terminal board on the underside of the chassis near the tube socket of V12.
4. Disconnect the center wire of the shielded antenna wire lead where it terminates at the terminal board on top of the chassis near the 6AB7 tube V12.
5. Ground the terminal from which this wire was removed.
6. Connect one end of a .0082 mfd capacitor to the free end of the wire removed in step 4 and add on a piece of wire to the other end of the capacitor, long enough to go through the chassis grommet. Connect it to pin 5 of the 6AB7 tube V12.

A typical power supply is shown in the

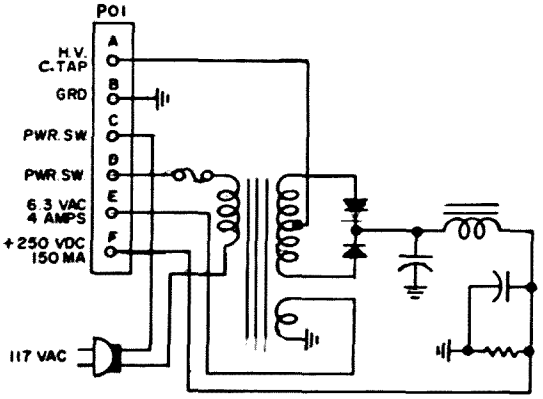


FIG 6

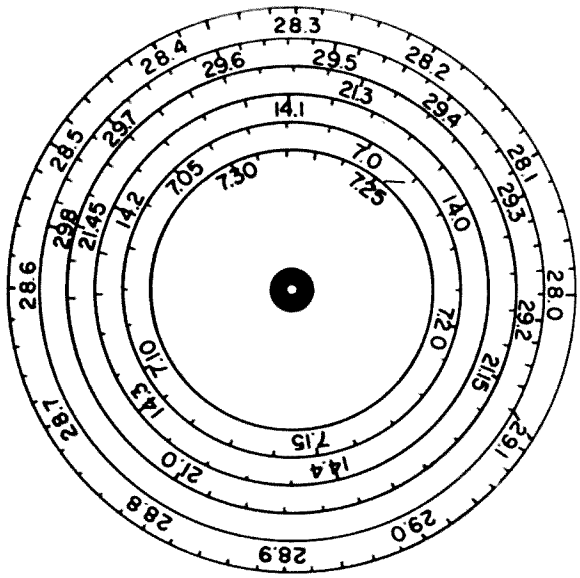
schematic of Fig. 6. No attempt is made to design an exact supply for the receiver in this article, since most users have power supplies capable of supplying adequate power to the receiver.

A white wire with blue and black tracer will be left over from the modifications. It may be cut close and left in the harness under the chassis.

A slot is cut in the cover to allow it to be slipped over the bandspread tuning knob. This shaft may be cut short enough to allow a knob to fit flush with the case cover.

A dummy knob is installed on the shaft on the front panel from which the stop mechanism was removed.

A bandspread dial is attached with cement to a ¾ inch diameter knob and installed on the tuning shaft. This dial is reproduced in Fig. 7 as a guide only because each receiver will vary slightly in calibration and the dial will have to be tailored to each case. A suitable pointer



for the dial is made from a short length of solid #20 wire which is attached under the screwhead of the nameplate. . . . W5UOZ

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1—Pin jack (RCA phono jack)
1—¾ inch dia. tuning knob (mount bandspread tuning dial to this knob)
1—6.3 volt 1.2 amp filament transformer
1—1N93 diode
1—10 mfd 150 volt elect. capacitor
1—500 ohm 5 watt resistor
1—3 lug terminal strip
1—6SD7 tube
2—1000 ohm ½ watt resistor
1—5000 ohm to 8 ohm output transformer, 5 watt
1—.02 mfd 600 volt capacitor
1—1 Mh rf choke

A Constant-Voltage Power Supply

Roy Pafenberg W4WKM

THE subject of using salvage TV receiver transformers for amateur power supplies has been exhaustively treated in the literature, notably by W1ICP in the QST series. There is, however, a power supply used in some of the earlier Dumont television receivers that is particularly desirable.

Some of these earlier sets used a constant-voltage transformer to offset the degradation in performance at reduced input voltage. These transformers were manufactured by Sola and were of the saturable reactor type. While they were used primarily to compensate for primary voltage variations, they also provide good regulation with changing load.

The RA-109 chassis, used in many sets marketed in 1951, is typical of those using the constant-voltage transformer. Although very fine sets, housed in good cabinets, many are being junked today and a little searching will dig them out.

The schematic diagram of the regulated supply used in the RA-109 chassis is shown in Fig. 1. Both the rectifier filament and the high voltage secondary windings of the transformer are regulated. The inductance of the high voltage secondary winding is tuned to resonance by the 2 mfd capacitor. Because of this resonant condition, a high circulating current flows in the winding, causing this section of the core to become saturated. Because of this saturation, the secondary voltage is relatively constant over a wide range of load and primary voltage variations.

Specifically, this transformer is designed to maintain the dc voltage output constant within $\pm 2\%$ for line voltage variations of $\pm 10\%$ from the rated 117 volts. This insures stable dc output for line voltages ranging between 105 and 129 volts. Only one precaution is required in amateur use of this supply. The nominal 2 mfd capacitor used to tune the secondary is hand selected in production to match the transformer used. Do not change the value of this capacitor or much of the regulating effect will be lost.

This particular supply is rated at 362 volts at 210 ma and no undue heating occurs at this load. This salvage power supply is a low cost answer to the critical voltage regulation problems encountered in many amateur applications. . . . W4WKM

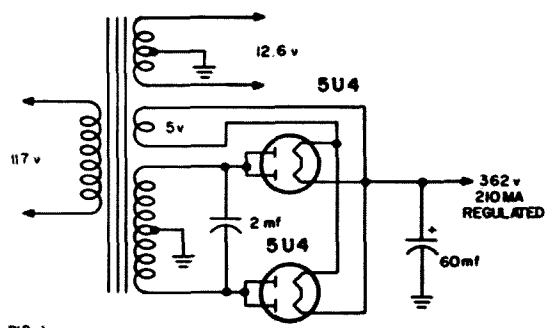


FIG. 1

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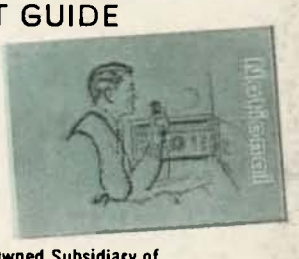
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